MEDICAL NUTRITION LABORATORY

NUTRITION SURVEY OF TWO CONSECUTIVE TRAINING CYCLES OF THE AIRBOURNE TRAINING BATTALION, CO. G, FT. BENNING, GEORGIA

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Report of

NUTRITION SURVEY OF TWO CONSECUTIVE TRAINING CYCLES OF THE AIRBORNE TRAINING BN. CO. "G", FORT BENNING, GA. OCTOBER-NOVEMBER 1953

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NUTRITION SURVEY OF TWO CONSECUTIVE TRAINING CYCLES, CO. "G", AIRBORNE TRAINING BN., FORT BENNING, GEORGIA, OCT-NOV 1953

OBJECT:

The purpose was to conduct a nutrition survey on two consecutive training cycles of a company of airborne trainees, during their strenuous three-week training course at a very high rate of physical activity. This study was a continuation of the previous camp surveys (1, 2, 3) performed by this Laboratory, which involves the systematic, periodic appraisal of Army messing facilities in units representing different service and combat branches with a wide range of physical activity and environment. The primary purpose of this survey was to determine (a) the total food consumption from all sources by these trainees, (b) the nutrient composition and the nutritional adequacy of the ration, (c) the nutritional status of the troops and (d) the energy balance of the troops. The study also included a comparison of the various methods of computing food consumption and food losses.

SUMMARY AND CONCLUSIONS:

Two consecutive training cycles of the Airborne Training Battalion, Company "G", Fort Benning, Georgia, were surveyed with the following schedule:

1st cycle		2nd cycle
	One	
12-16 Oct	week	9-13 Nov
19-23 Oct	between	16 thru 25 Nov
26-30 Oct	cycles	(inclusive)

The food consumption derived from the mess alone, as calculated by the various methods, ranged from 3147 to 3446 calories per man per day (Fig. 1), but when the total food consumption from all sources is considered, the intake was 3878 to 4238 calories. The daily food consumption from sources outside the mess averaged 731 calories per man per day, or a difference of 17.2 to 18.9 per cent of the total food consumed.

The protein consumption from the mess alone (Fig. 2) was 111.2 gm. by the chemical method and 115.3 gm. per man per day by the inventory method. These values were above the basic dietary standard of 100 gm. a day.

The total edible food losses averaged 767 calories or 18.5 per cent of the total edible food available (Table XII) by the inventory method and 792 calories per man per day or 18.7 per cent of the total edible food available from the mess, using the chemical method in which carbohydrate is determined by weight difference.

Two variations of the chemical food analysis method were used, differing only in the method of carbohydrate assay: (a) by direct determination of hydrolyzable reducing sugar and (b) by determination by weight difference (total dry weight of food - protein - fat - crude fiber - ash).

As noted in previous reports from this Laboratory the disagreement among the various methods was due largely to the discrepancies in the direct chemical method of carbohydrate determination of reducing sugars (Table IV). These values were 74.9 gm., or 300 calories, lower than the carbohydrate by weight difference method.

The fairly good correlation between the chemical and inventory methods can be attributed to (a) improvements in the inventory method, using recipes and observed refuse data, (b) the correction of the bomb calorimetry data using the more specific Atwater factors and (c) the use of carbohydrate by weight difference method in computing the chemical data.

RECOMMENDATIONS:

1. Nutrition surveys should be undertaken on units operating in cold, hot-humid, and hot-dry environments. The previous surveys have been on units in temperate environments, with wide ranges of physical activity between the units.

2. The carbohydrate "by weight difference" method only should be used to determine carbohydrate, until such time as a good chemical method for carbohydrate in food composites is developed.

3. Experiments should be designed and conducted to study the problem of physiologically versus chemically available carbohydrate.

4. Studies of factors affecting the voluntary intake of fat should be undertaken.

5. Data in all the previous company mess surveys should be consolidated and uniformly recalculated in accordance with the following procedures:

a. Bomb calorimetry data corrected for nutrients, using the Atwater corrections and correction of gross bomb energy to net metabolizable energy (Appendix VI).

b. All direct chemical data corrected, using the carbohydrate "by weight difference" method.

c. The elimination of the data for direct chemical analysis of carbohydrate in the calculation of calories.

d. The calculation of the inventory method using new waste data.

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INTRODUCTION

This survey is the fourth in a series of nutritional appraisals at troop messes. Other mess surveys have been performed at Fort Sheridan, Illinois (1) on a company of Military Police in relatively sedentary occupations; at Camp Pickett, Virginia (2) on two companies of the Medical Replacement Training Battalion, on trainees in their first eight weeks of basic training; and at Fort Riley, Kansas, on two companies of the 10th Infantry Division (3), on trainees in their last eight weeks of basic training. For this appraisal, two consecutive training cycles of airborne trainees were selected from the Airborne Training Battalion, 1st Student Regiment, Fort Benning, Georgia, during their very strenuous three-week training at a high rate of physical activity.

This study was instituted to gather information on (a) the food consumed by these troops in the mess, as well as food consumed from other sources, including Post Exchange facilities, snack bars, cafeterias, food from home, etc., (b) the nutritional adequacy of the ration that was consumed, (c) the determination of the energy balance of this group, derived from time motion studies, food consumption, and changes in body weight, and (d) the nutritional status of these troops. The studies (c and d) on energy balance and nutritional status will be reported separately.

THE MESS SURVEYED

The physical setup of the mess was similar to that of other company messes surveyed in the past, however it was inadequate for the number of men fed, averaging, for example, between 310 and 320 men at the noon meal during the second cycle. As a result, the first men in line at meal times had to rush through their meal to make room for the trainees at the end of the line.

Mess Personnel. The mess hall was under the supervision of the company executive officer, a 1st Lieutenant in the Airborne Infantry. His staff included a mess sergeant, an assistant mess sergeant, and a first cook who was assisted by two additional cooks on each shift. One baker baked for the whole company. The cooks were assisted by nine trainees assigned to K. P. detail each day. The mess personnel cooperated wholeheartedly with the members of the survey team when they realized that no attempt was made by the survey personnel to alter the existing mess practices.

Food Preparation. The Army recipe manual TM 10-412 (6) served as a general guide for the preparation of food items, but many deviations were practiced. The preparation of fried foods was always a problem because of the shortage of grills and, as a result, these items were never cooked well enough. Food was always prepared in advance and, as a result, was usually cold, tasteless, and dry.

SELECTION OF TRAINEES SURVEYED

The selection of the trainees who were surveyed was made arbitrarily by inspection of the training schedule in the office of the S-3, Airborne

Infantry Battalion. The actual dates of the survey had been chosen two months in advance. Company G, Airborne Infantry Training Battalion, 1st Student Regiment, was selected (Fig. 9 and 10), since they began their training on 12 October. The dates of the consecutive 3-week training cycles were as follows:

1st cycle		2nd cycle
12-16 Oct	One week	9-13 Nov
19-23 Oct	between	16-25 Nov (included
26-30 Oct	cycles	one weekend)

The survey periods began on Monday morning and lasted through Friday evening of each week, except for the period of 16-25 November, where the period was extended for ten consecutive days. This last period was necessary since the three-week training period during the second cycle was shortened because of Thanksgiving Day.

Number of Men Served. During the first cycle, the mess hall served an average of 999, 984, and 903 meals per day for each week of the three-week cycle. During the first week of the second cycle, the mess averaged 774 men per day and 744 meals per day for the last ten days. The table below presents the daily breakdown of the head count.

Head Count, Average Men Per Day*

	Days	1	2	3	4	5	Ave/Week	Ave/Cycle
	12-16 Oct	352	343	342	315	315	333	
First	19-23 Oct	335	332	314	334	326	328	321
Cycle	26-30 Oct	295	299	300	318	293	301	
	9-13 Nov	287	305	153	281	266	258	
Second	16-20 Nov	274	280	279	276	272)		251
Cycle	21-25 Nov	191	146	267	271	223)	248	
							Weighted Average, Two Cycles	286

*Based on average head count for three meals

PERSONNEL OF TEAM

The survey team consisted of 22 personnel including the following: the Commanding Officer (MSC) of the Medical Nutrition Laboratory; two officers (WMSC dietitians); one officer (MSC) in charge of supply; one senior civilian, the Survey Director; one civilian statistician; seven qualified scientific and professional enlisted personnel; three EM laboratory technicians; two EM drivers; one EM mechanic; one EM statistician; one EM photographer; and one EM clerk-typist. Most of this group had been working together for at least one year and had been especially selected for a specific assignment on this survey. (For assignment of duties see Appendix V).

EQUIPMENT OF THE SURVEY TEAM

The equipment brought to Fort Benning consisted of a large tractor-trailer mobile laboratory unit, a small house trailer (converted to a mobile laboratory), one cargo trailer, and two 3/4-ton trucks. The mobile laboratories contained all the equipment necessary to perform the chemical procedures for this study. This equipment included a large 25 KVA generator, a portable 5 KVA generator, two electrically heated digestion racks for Kjeldahl total nitrogen determinations, two all-glass distillation units, one oxygen bomb calorimeter, two accurate direct-reading Gramatic balances, two spectrophotometers, one large drying oven, one vacuum oven, two incubators, one large refrigerator, a deep-freeze, one large food grinder, and a large assortment of chemicals and glassware.

Because of the anticipated work load in the chemical laboratory, a large empty mess hall (Fig. 8 and 11) was utilized, and part of the equipment was set up there. However, fat extractions were performed in the small mobile trailer, the Kjeldahl digestion of proteins was performed outdoors, and the distillation units for protein analysis were set up in the large trailer (Fig. 7). Both of the mobile laboratory units were parked adjacent to the mess hall, which also supplied the trailers with water and electricity.

METHODS OF SAMPLING AND NOMENCLATURE

In order to provide the necessary data for the calculation of the caloric and nutrient intake of the troops, the following representative composite samples were collected; food as taken on tray, plate loss, kitchen loss, tray wash, grease trap, and rendered fat. All preparation loss (inedible) was weighed by item, recorded, and discarded.

NOMENCLATURE OF FOOD COMPOSITES AND FOOD LOSSES

1. Food composite as taken on the tray. During each meal, one of the survey personnel collected five average and representative servings of each food item served at that particular meal. The composite samples were made up of representative aliquots of each food item served, weighted in terms of the total quantity of the food item taken on the tray and divided by the head count. As it represented the quantity of food taken per man, it can be defined by the following equations:

$$\text{Food prepared for serving} = (A_2 - A_1) + (B_2 - B_1) + (C_2 - C_1), \text{ etc.}$$

$$\text{Average meal as taken on the tray} = \frac{A_2 - A_3}{M} + \frac{B_2 - B_3}{M} + \frac{C_2 - C_3}{M}, \text{ etc.}$$

a) where A, B, and C, etc. represent the individual food items,
b) where A_1, B_1, C_1, etc. represent the weights of the empty pans,
c) where A_2, B_2, C_2, etc. represent the full weights of the food pans,
d) where A_3, B_3, C_3, etc. represent the weights of the food pans and the contents after serving the food items A, B, C, etc., and
e) where M equals the total head count for the meal, or the total number of men fed. (See Appendix VII and VIII).

The composites from each meal were combined at the end of each day and homogenized, usually with the addition of a weighed amount of water. The average amount of sugar consumed per man was added at this time, sugar being recorded on a per man per day (PMPD) basis. The total sugar consumed was divided by the average head count per meal to obtain the PMPD average.

The homogenized composite was analyzed chemically for protein, fat, carbohydrate, moisture, ash, crude fiber, and total calories using the bomb calorimeter.

2. Plate loss. The plate loss sample was a composite of all the edible food left on the tray and was weighed and collected by food item after each meal. At this time non-edible portions of the plate scrapings were removed (bones, rinds, and pits), weighed, and discarded. In the calculations, non-edible plate loss was subtracted from the weight values of the respective items "as served on tray" and added to "preparation loss", item 7 below. The remaining edible portion was combined for each meal, weighed and ground in a large food grinder (Fig. 6). The ground sample of plate loss was mixed, usually with the addition of a weighed amount of water, and an aliquot was removed to be homogenized in a Waring Blendor; to be analyzed for protein, fat, carbohydrate, ash, crude fiber, moisture, and by bomb calorimetry (Fig. 12).

3. Kitchen loss. All food which was prepared, but not served, and was eventually discarded, was collected as kitchen loss (Fig. 5). In addition, all unused dough, egg batter, burnt toast, and all other edible food loss of similar nature was placed in the kitchen loss sample. This sample was ground at the end of each day, mixed well, weighed and an aliquot taken to be homogenized.

The homogenized samples of on tray, plate loss, and kitchen loss were each divided into two portions, one used for analysis immediately, and the other stored in a deep-freeze for future use. Samples for analysis were stored in a refrigerator when not being used.

4. Rendered fat drippings. All fat that was generated and collected in the course of meat preparation, that was eventually discarded, was classified in this category. This group included drippings from bacon, roasts, hamburgers, etc. This sample was collected over the entire survey period, weighed, and an aliquot was analyzed for fat alone.

5. Grease trap skimmings. In this survey, we assumed an average value for grease trap skimmings, based upon data from previous surveys.

6. Tray wash water. In this survey, we assumed an average value for the tray wash sample also, based upon data from previous surveys.

7. Preparation loss, inedible. During the preparation of food items there were inevitable losses which were referred to as preparation losses. This category included all inedible parts such as bones, fruit rinds, pits, egg shells, and vegetable trimmings. These items were weighed individually, recorded, and discarded.

8. Total kitchen loss. For the sake of simplicity in the calculation of food losses, the kitchen loss also included the rendered fat drippings and grease trap skimmings (3, 4 and 5 above).

METHODS FOR THE CALCULATION OF FOOD CONSUMPTION

1. Chemical Methods.* These provided the first method for determining the nutritional content of the diet.

Food as taken on tray, plate loss, and kitchen loss composite samples were analyzed for protein, fat, and carbohydrate; and the rendered fat sample analyzed for fat alone. For the food as taken on tray and plate loss samples, moisture, crude fiber, and ash were determined using the official AOAC methods (7). The caloric content was determined directly on the vacuum-dried food samples by oxygen calorimetry (8).

Protein was determined by the Keys-micro-Kjeldahl method (Fig. 13) as described by Consolazio, Johnson, and Marek (9), using concentrated sulfuric acid and a phosphate-copper sulfate catalyst.

Fat (Fig. 14) was determined by a modification of the AOAC-Mojonnier method (7) using an ether-petroleum ether extraction after 1.5 hours of hydrolysis in hot concentrated hydrochloric acid.

The carbohydrate determination was made by a modification of the Somogyi (10) and Nelson (11) colorimetric methods using a zinc hydroxide filtrate (12) after three and one-half hours hydrolysis in 1.0 N sulfuric acid (H_2SO_4) in a boiling water bath.

After determining the grams per cent of protein, fat and carbohydrate, the caloric content of the diet was calculated using the energy equivalents of 4, 9 and 4, respectively (13).

2. Long Inventory Method** for Determining Food Consumption. The long method of inventory is another method used to compute food consumption. In this method, an initial inventory is performed and a record is kept of all the food that is brought into the mess daily during the period of the survey. On the final day of the survey, after the last meal, another inventory of all the food items on hand is made. The difference between the initial inventory, with the addition of all issues processed during the survey period, and the final inventory will give the weight of food that has been utilized during the survey period. This value, less the food losses (preparation loss, plate loss, kitchen loss, unused fat drippings, tray wash fat, and grease trap fat) will give the weight of the food consumed and using standard food tables, this weight is converted to calories. By dividing the total calories by the product

* To avoid confusion, the chemical method referred to in this paper included the direct determination of carbohydrate from reducing sugars after acid hydrolysis.

** In all cases where inventory method is referred to in the text, it means the MNL method, using actual observed refuse data.

of the average daily head count and the number of days in the survey, the intake PMFD is obtained. For detailed operation see Appendix I.

3. Bomb Calorimetry. The third method of determining the food consumption was by direct bomb calorimetry (8) (Fig. 12). Samples of food as served on tray, plate loss and kitchen loss were analyzed for their total caloric content by burning a weighed sample of vacuum-dried material and recording the temperature rise in a weighed amount of water. These data were then corrected for the caloric equivalent of all the nutrients using the Atwater corrections (5). For example see Appendix II.

4. Chemical methods, carbohydrate by weight difference. The carbohydrate by weight difference was calculated by computing the total per cent solids of the food composites and subtracting the grams per cent of protein, fat, crude fiber and ash as determined by chemical analysis. The caloric content was calculated using the energy equivalent of 4 calories (13). For example see Appendix III.

5. Food eaten outside of the mess hall. It is generally acknowledged that a great deal of food is consumed by the individual outside of the Army mess. Actual investigation (1, 2, 3) by this laboratory has shown that the outside mess consumption is approximately 18% of the total food consumed from all sources. As a consequence, it has become very desirous to obtain a record of the amount and type of foods consumed in this manner. A questionnaire was developed as the most expedient method of accomplishing this with the limited manpower available on the survey team.

The questionnaire was a listing of popular food items that included alcoholic beverages, peanuts, milk and ice cream, and a complete meal. Opposite each item was a row of boxes, one for each day of the survey period, and arranged in columns under the appropriate heading for each day. At the top of the form was a brief paragraph explaining the form and demonstrating how to mark in the boxes. At the bottom of the page was a line for the signature of the individual.

The forms were distributed to the troops the evening before the first day of the survey. At this time they were told what the forms were for, how to use them, and when to start. It was very helpful to have someone with authority within the company, such as the company commander or the first sergeant, speak to the men at a formation and impress upon them the necessity for filling out the forms truthfully each day. In connection with the last mentioned request, the survey personnel made frequent and periodic questionnaire checks, preferably in the evening when the troops were in the barracks.

On the morning after the end of the survey, the forms were collected. It was important that the forms be signed in order to substantiate or throw out questionable records.

The questionnaires were then tabulated by item and the total consumption of each item was thus obtained; from this, the caloric value, and grams of fat, protein, and carbohydrate of the food were calculated.

The fact that some of the subjects were present for only a fraction of the survey period was taken into account when converting the total amounts into the per man per day basis. A simple method for calculating intake on a per man per day basis was used, rather than the average number of subjects.

For example, each man who was present for the entire period and turned in an outside mess form was listed as ten man days. Again, those who were present for six days were valued at six man days. By adding up the total man days, and then dividing into the total number of calories and nutrients, the calorie and nutritive values on a per man per day basis were obtained. See Appendix IV for example of calculation.

6. Food eaten between meals at mess hall. In the course of food preparation in the mess halls, a considerably amount of food is eaten by the mess personnel, K.P.'s, and the training company's NCO's and officers. This food may include such items as sandwiches, cake, pies, milk, cream, and sugar for coffee. A daily tally of each food item was recorded and totaled, and at the end of the survey period the totals were converted to calories and the nutrients.

RESULTS

CHEMICAL ANALYSIS OF FOOD COMPOSITE SAMPLES.

1. Food as taken on the tray and consumed as determined by chemical analysis. A summary of the chemical analysis data of the composites of "food as taken on the tray" and the several categories of waste is presented in Tables 1 to 5 and Figs. 1 to 4. The results are presented in averages for each cycle and a weighted average of the two cycles. These tables present the distribution of calories, protein, fat and carbohydrate in terms of eight different fractions, and by two different methods, specifically, for calories and the quantity of carbohydrate. Included in these charts are the data concerning energy content and the nutrient composition of the total edible portion, portion consumed, and portion of food loss as calculated by the inventory, bomb calorimetry, and carbohydrate by weight difference methods. The data on inventory method analysis are discussed in detail in a later section.

A. Calories: chemical method using carbohydrate by weight difference. The potentially edible portion, which in addition to the food taken on trays, includes kitchen loss, fat drippings from meat and grease trap skimmings, averaged 4204 calories PMPD* (per man per day) for the first cycle, 4283 calories for the second cycle, and 4238 calories for the average of both cycles (Fig. 1 and Table 1). However, the food that was actually served on the tray averaged 3614, 3697, and 3651 calories PMPD for the same respective periods. The plate loss, which includes fat left on the trays (tray wash), for the same periods was 250, 242, and 246 calories PMPD, or 6.7% of the food served on the tray. The average total calories consumed PMPD, calculated by subtracting the plate loss and tray wash from the food as served on tray, was 3364, 3455 and

*To avoid needless repetition of words the terms PMPD will refer to per man per day.

3405 calories PMPD for the first cycle, second cycle, and average of the two cycles, respectively.

The total waste, calculated from weighted averages, was 18.7% of the total edible portion. The food eaten between meals at the mess amounted to an average of 41 calories, which raised the average total consumption in the mess to 3147 calories by the chemical method using direct carbohydrate determination, 3446 calories by the chemical method using carbohydrate determination by weight difference, 3305 calories by bomb calorimetry and 3377 calories by the inventory method.

Table XIII shows the average caloric equivalent of the total edible portion and of the food consumed in the two cycles, as determined by chemical (direct determination) and inventory methods. The values were 3881 and 3972 calories for the total edible portion of food at the mess and 4612 and 4723 calories of the edible portion from all sources. However, the total consumed from all sources was 3878 and 4108 calories respectively.

B. Protein. The average protein content (Table II) of the potentially edible protein was 119.0 gms. PMPD for the first cycle, 129.2 gms. for the second cycle and 124.2 gms. for the average of both cycles; but here again for the same periods only 110.8, 122.4 and 116.8 gms. PMPD were served. The plate loss for the same periods contained 7.3, 7.9 and 7.6 gms. PMPD, respectively. This resulted in an actual protein consumption from the mess, exclusive of the in-between meal eating of 103.5, 114.5, and 109.2 gms. PMPD for the before-mentioned periods. The total food loss was 10.5% of the total edible portion of protein. The food eaten between meals at the mess averaged 2.0 gms. which raised the total average consumption from the mess to 111.2 gms. PMPD.

C. Fat. With respect to the potentially edible fat (Table III) for the same periods, the averages were 239.5, 228.0 and 233.6 gm. PMPD, with the fat as served on the tray amounting to 188.8, 177.7 and 183.2 gm. PMPD, respectively. The plate loss and tray wash accounted for 15.8, 14.7 and 15.2 gm. PMPD and, by difference, the actual daily fat consumption from the mess alone and exclusive of the in-between meal eating, was 173.0, 163.0, and 168.0 gm. per man. (The total food loss was 26.9% of the total edible portion of fat available.) The in-between meal eating at the mess averaged 2.1 gm. of fat, which made the total consumption from the mess alone 170.1 gm. PMPD.

D. Carbohydrate.

Direct Chemical Analysis. As determined by chemical analysis, the carbohydrate (Table IV) for the total edible portion available averaged 306.6, 339.9 and 323.3 gm. PMPD for the first cycle, the second cycle, and average of the two cycles, respectively; and the food as served on tray averaged 286.1, 322.8 and 304.5 gm. PMPD for the respective periods. The plate loss was 14.3, 16.2 and 15.4 gm. PMPD, and the daily consumption, from the mess alone, exclusive of the in-between meal eating, was 271.8, 308.6 and 289.1 gm. PMPD. The total food loss was 9.5% of the edible portion of carbohydrate. The in-between meal eating at the mess averaged 3.6 gm. for both cycles raising the total consumption to 292.7 gm. of carbohydrate PMPD.

Carbohydrate by weight difference (Table IV). The total consumption of carbohydrate from the mess, calculated "by weight difference" (Tables IX and X) was 348.4 gm. PMPD for the first cycle, 382.5 gm. PMPD for the second cycle, and 364.0 gm. PMPD for the average of both cycles. These values are 71.3 gm. higher than those derived from the chemical analysis by acid hydrolysis and 31.5 gm. lower than the results derived from the inventory method. For an example of the calculation see Appendix III.

The total energy value of the food consumed in the mess, calculated on the basis of carbohydrate by weight difference method, was 3446 calories PMPD (3405 plus 41 calories in between meals at mess). This value is 299 calories, or 8.7% more than by the chemical method, 196 calories or 5.7% more than the method using bomb calorimetry and 69 calories or 2.0% more than the standard inventory method.

E. Food Losses. During the preparation of food in the mess kitchen, other food losses besides those of plate scrapings occur. These avenues of loss include kitchen loss, preparation loss, fat drippings from meat, grease trap skimmings*, and tray wash water*. These values are summarized in Tables I to V.

Kitchen Loss. The daily average PMPD discarded as kitchen loss was 175 calories by the direct chemical method and 212 calories by the weight difference method (Table I). These values were 27.4 and 26.8 per cent of the total food loss, respectively (Table XI).

Rendered Fat from Meat Drippings. The rendered fat loss (Table I) averaged 270 calories PMPD for the first cycle, 297 for the second cycle, with an average of 284 calories for the two cycles or 35.9% of the total calories attributed to food loss, using the weight difference method.

Grease Trap Skimmings. Grease trap skimmings account for another source of food loss. The accumulation of fat in these traps each day is usually derived from the cleaning of pots and pans. For this survey a constant value of 50 calories PMPD was assumed since one of the fittings for the grease trap pipe was broken during the entire period of the survey. The value was an average derived from three previous company surveys conducted by this Laboratory.

Tray Wash Water. Because of the tremendous workload at Fort Benning, Georgia, the fat in the tray wash water was not analyzed chemically. An average value of 15 calories PMPD derived from the three previous company surveys conducted by this laboratory was used.

Plate Loss. The plate loss plus the tray wash water (Table I) averaged 225, 246, and 218 calories PMPD for the direct chemical, the carbohydrate by weight difference, and the inventory methods.

These values were 30.6, 31.1 and 28.4 per cent of the total calories attributed to food loss by the same methods respectively (Table XI).

*These values are assumed in this report.

Total Edible Food Loss from all Sources. The total food loss (plate loss, kitchen loss, rendered fat drippings, grease trap, and tray wash water) averaged 792 and 767 calories PMPD for the entire period of the survey by the weight difference and inventory methods (Table XII). The percentage contribution to this energy loss from protein, fat and carbohydrate was 6.6, 72.4 and 21.0% respectively using the carbohydrate by weight difference method. The total food loss as determined by the various methods was 18.9% of the total edible portion available by the direct chemical method, 18.5% by the inventory method and 18.7% by the weight difference method.

The data summarized in Table XI shows the total edible food loss data in terms of pounds PMPD and calories per gram. The plate loss averaged 2.32 calories per gram of edible loss, the kitchen loss 4.87 calories per gram, with the total edible loss averaging 3.53 calories per gram.

INVENTORY METHOD USING RECIPES OF RAW AND COOKED FOOD ITEMS.

In Appendix I the use of the inventory recipe method for the calculation of food consumption has been described. In Table VI data are presented showing the disposition of calories and the nutrients consumed as computed by the inventory method, using recipes. The data include food consumed and "as prepared" (total edible portion), using actual food loss data as observed in the preparation of food in the mess and food "as prepared" using food loss data values in the U. S. Department of Agriculture Handbook No. 8, Tables of Food Composition (14).

A. Calories. The total edible portion or "as prepared" (Table V and Fig. 1) using actual observed food loss data were 4127, 4180 and 4144 calories PMPD for the two cycles and the average of the two cycles, respectively. These values were within 30 calories of the data for the total edible portion using the food loss data as given in the USDA Handbook #8 (14) and 263 calories of the total edible portion as computed by the chemical method, using the data derived by the determination of reducing sugar.

The values for food consumed in the mess were 3318, 3436, and 3377 calories PMPD for the inventory method which was 271 calories, or 8.0%, higher than the chemical method using determination of reducing sugars, and 69 calories, or 2.0%, lower than the chemical method using carbohydrate by weight difference.

B. Proteins. The values for protein analysis (Table V and Fig. 2) by the inventory method, using actual food loss data were 127.0, 133.6, and 130.6 gm. PMPD for the total edible portion. The average value was within 1.4 gm. of protein using the USDA Handbook #8 (14) corrections for refuse, and 6.4 gm. of the chemical analysis data.

The actual consumption of protein by the inventory method (Table VI) was 110.5 and 120.0 gm. in the first and second cycle, respectively, with an average of 115.3 gm. PMPD or 3.6% more than the chemical method.

C. Fat. As summarized in Table V, the total edible portions of fat, using observed food loss data were 203.8, 198.5, and an average of 207.0 gm.

PMPD as compared with values of 217.0, 200.0, and an average of 209.4 gm. PMPD of fat by the inventory method, using USDA Handbook #8 (14), and 239.5, 228.0, and 233.6 gm. PMPD by the chemical method.

The fat consumed (Table VI and Fig. III) was 150.8 and 144.0 gm. by the inventory method, with an average of 147.4 gm. PMPD, or 13.3% lower than by the chemical method.

D. Carbohydrate. The total edible portion (Table V) of carbohydrate by the inventory method, using observed food loss data amounted to 432.4 and 478.6, with an average of 452.5 gm. PMPD for both cycles. The values using the USDA tables were 435.2 and 480.8 with an average of 454.5 gm. PMPD, and the values using the chemical method for reducing sugars were 306.6, 339.9 and 323.3 gm. PMPD, or about 28.9% lower than the former values.

The carbohydrate consumed in the mess (Tables IV and VI) as determined by the inventory method was 371.4, 427.9, and 395.5 gm. PMPD as compared to an average of 292.7 gm. PMPD by the chemical method of reducing sugar and 367.6 gm. PMPD by the weight difference method.

E. Food Losses (Table XII). The total edible food loss averaged 767 calories PMPD by the inventory method or 18.5 percent of the total edible available food. The plate loss averaged 217 calories, kitchen loss 216 calories and rendered fat and grease trap 334 calories PMPD.

BOMB CALORIMETRY

Food served on tray and consumed as determined by bomb calorimetry: When the body burns materials of a mixed diet which it has previously absorbed, it obtains on the average 4.1 calories per gm. of carbohydrate, 9.45 calories per gm. of fat, and 4.35 calories per gm. of protein, but it has available, after fecal loss, on the average 98% of the carbohydrate, 95% of the fat, and 92% of the protein (Sherman)(5). On this basis, the approximate conversion factors or energy equivalents from grams to calories are 4 for protein, 9 for fat, and 4 for carbohydrate.

When foods in a mixed diet undergo complete oxidation in the bomb calorimeter, they yield the following approximate heats of combustion: 4.1 calories per gm. of carbohydrate, 9.45 calories per gm. of fat, and 5.65 calories per gm. for protein. As a result, all the data derived from bomb calorimetry must be corrected for protein, fat and carbohydrate. (See Appendix II on calculation of calories by bomb calorimetry). The corrected bomb calorimetry data for calories consumed at the mess are presented in Table VII.

The observed corrected data for calories consumed were 3126 calories PMPD for the first cycle, 3294 calories PMPD for the second cycle, and 3209 calories PMPD for the average of both cycles. This was 63 calories higher and 167 calories lower than the values derived by chemical or inventory methods, respectively.

TOTAL FOOD CONSUMPTION.

1. Food consumed outside the mess: As mentioned previously, the main sources of food consumption other than at mealtimes are between meal eating at the mess and sources outside of the mess facilities.

Table VIII shows the following distribution of the nutrient composition of food eaten between meals at the mess, the average PMPD being 40.8 calories; 2.05 gm. protein, 2.10 gm. fat, 3.60 gm. carbohydrate.

The tabulated data of the food eaten from sources outside the mess, as determined by questionnaire, are also presented in Table VIII. The average calories PMPD for the first cycle of training was 653, for the second cycle 778, with an overall average of 731 calories for both cycles. The averages PMPD of both cycles for the nutrients were 16.5 gm. of protein, 31.0 gm. of fat, and 92.1 gm. of carbohydrate. This value is 17.5 percent of the total food consumed using the carbohydrate by weight difference method and 17.8 percent of the total food consumed using the inventory method.

2. Food from all sources: The summary data for the total energy consumption from all sources are shown in Table IX. These sources include food eaten in the mess at mealtimes, food eaten in the mess between meals and food eaten from all sources outside the mess. These average values for the two cycles are: 3878, 4149, 4238 and 3981 calories PMPD as calculated by the direct chemical method, the long inventory method, carbohydrate by weight difference method and the corrected bomb calorimetry method, respectively.

BODY WEIGHTS AND ENERGY EXPENDITURE USING TIME MOTION STUDIES.

The analysis of body weight data and the energy expenditure data will be discussed by the Field Experiment Division in their section of the Fort Benning, Georgia, report.

DISCUSSION - GENERAL CONSIDERATIONS

1. Some aspects of the psychological effects of surveying on the phenomena surveyed. As discussed in the Camp Pickett (2) and Fort Riley reports (3), the psychological effects on the personnel of a training company being surveyed must be considered since the mere presence of a survey team will influence the results. The mess and administrative personnel are immediately alerted and either consciously or subconsciously do not aid in solving the problems that confront the survey team. In addition to the possibility of their being antagonistic or apathetic, the most common changes that occur are changes in the preparation, cooking and serving of food by the mess personnel, the very frequent inspections by all groups, the omission of the coffee and cake periods between meals by NCO's and officers, and the apparent increase in the food issue. Usually at the end of the first week of the survey, things are back to normal.

2. Discrepancies in the results by all methods. After a careful and critical study of the different methods used to calculate food consumption, the most obvious discrepancies are found in the fat and carbohydrate results

(Figs. III and IV), even though the data for total calories and protein are in good agreement (Figs. I and II). The total calories consumed in the mess by all methods are within 300 calories, the inventory method being 7.9% higher than the chemical method, 4.9% higher than the bomb calorimetry data and 1.1% lower than the method using carbohydrate by weight difference. If one eliminates consideration of the energy consumption as determined by the direct chemical method, the intake from the mess alone (at meals only) is within 196 calories (5.8%) of the other methods. The caloric content of the potentially edible portion ("as prepared") was in fair agreement by all methods, having a spread from the highest to the lowest values of only 360 calories or 8.5%.

In this survey, the very close agreement in food consumption by the various methods can be attributed largely to improved methodology; the inventory method using recipes, the correction of the bomb calorimetry data using complete oxidation corrections for all the nutrients, and the use of the carbohydrate by weight difference method.

As mentioned above the protein consumption in the mess by the chemical method and inventory method were in close agreement, or within 3.7%.

As in previous reports (1, 2, 3) the chemical method for determining carbohydrate in foods using acid hydrolysis, yields much lower results than those obtained by inventory and "by weight difference" methods: 26 and 20.4% lower, respectively. These differences have also been reported by McCay et al. (15a to e) in the surveys conducted during World War II at Naval installations, and as discussed in the MNL reports (1, 2, 3), the difference is entirely due to the failure of recovering all the carbohydrate present using the chemical method. In a recent study in our laboratory by Friedemann and Lynch (16), it was noted that these discrepancies may be due largely to the destruction of fructose during the hydrolysis. On the basis of all the past work in our laboratory and elsewhere, one can safely state that until a good chemical method is available for carbohydrate, the "by weight difference" method is the only satisfactory method for determining carbohydrate in food composites.

The discrepancies in the food consumed data for fat by the chemical and inventory methods are not as great as the variations in carbohydrate since one must consider the many avenues of fat losses. The 13.3% difference can be attributed in part to the difference in methodology and in part to differences in Army procurement procedures, particularly of meats which may lead to supplies of foods with greater fat content than those which provide the average composition of the U.S.D.A. Tables (14)

5. Relationship of total edible calories to the total combined food loss. The total edible loss was 18.7% of the total edible calories as served in the mess using the "by weight difference" method, and 18.5% of the total edible calories using the inventory method. Whether all this food loss is edible or not is debatable, since one must consider that the food loss contains at least 72.4% fat as analyzed chemically.

4. Fat calorie ratio. During the nutrition surveys at the various company messes, the data collected indicated that the American soldier is consuming a

large percentage of his calories in the form of fat. According to the Food and Nutrition Board of the National Research Council (1953)(17), the percentage of calories available from fat has increased from 32 to 40 percent in the United States in the past 32 years; this does not necessarily represent an actual increase in consumption because no data are available on food losses.

The table below presents the fat-calorie ratio of the total edible food available at the mess:

Method	Total Edible Portion	Percent of Calories from Fat
Chemical, direct CHO determination	3881	54.0
Chemical, CHO by weight difference	4238	49.6
Inventory	4144	44.4
Bomb calorimetry	4042	51.9

As noted in this table, the percent calories available from fat is from 44.4 to 54.0 percent by the various methods. These values are considerably higher than the data presented by the National Research Council (1953)(17).

The following table is a recapitulation of previous data on the food consumption (based on the calculation, utilizing carbohydrate as determined by the "weight difference method"), the calories derived from fat, and the ratio of fat calories to total calories as published in reports from this Laboratory (1, 2, 3). It will be noted that the calories from fat vary from 39.3% at Camp Pickett, Virginia, to 44.4% at Fort Benning, Georgia.

Camp	Total Calories Consumed from Mess Alone	Calories from Fat	Percent Calories from Fat
Ft. Sheridan, Ill.	2770	1118	40.4
Camp Pickett, Va.	3121	1228	39.3
Ft. Riley, Kan.	3414	1476	43.2
Ft. Benning, Ga.	3446	1530	44.4

A major source of data on the fat-calorie relationship of diets can be obtained from the work of Kark, et al. (18) on military personnel, and from Keys, et al. (19, 20) in data dealing with serum cholesterol levels and its relationship to atherosclerosis throughout Europe and the United States. Anderson, et al. (21) in their work with Mexican Indians noted that the fat intake was only 10 percent of the total calories, but that these Indians had no pronounced nutritional deficiencies.

The following table is a compilation of data found in the literature:

Country	Percent of Fat Calories in the Diet	Age Group
Madrid, Spain (civilian)(20)	27	26
England (civilian industrial workers)(28)	35	20-65
Slough, England (civilian)(19)	35.4	40-55
England (National Food Survey, 1949)(28)	35.3	18-28
Amsterdam, Holland (civilian)(20)	34	30
Denmark (civilian)(20)	34	24
Minnesota, U.S. (civilian)(20)	40	
Naples, Italy (civilian)(19)	20	20-54
Georgia, U.S. (civilian)(27)	42.3	
Otomi, Mexican Indians	10.0	21-50
English Cadets (military)(23)	34	19.9
U. S. Troops, Zone of Interior (1941-43)(24)	43	
U. S. Troops, Zone of Interior (1946)(25)	44	
U. S. Troops, Ft. Churchill, Canada (26)	37.6-42.8 (winter)	
U. S. Infantry Troops, Alaska (22)	34.8-37.0 (year round)	
U. S. Air Force Troops, Alaska (22)	44.0-47.0 (winter)	
U. S. Air Force Troops, Alaska (22)	35.0-37.0 (summer)	
Canadian Troops, Canada (17)	42 (winter)	
U. S. Troops (South Pacific Area)(18)	32-34	

These data indicate that the diet of the American soldier provides more calories from fat than any other group studied through the United States and Europe. As stated above, no one at the present time can safely state whether an increased fat-calorie ratio in the diet is detrimental or beneficial to humans since little or no information is available in the literature on the human requirement of fat. This study should be pursued for further clarification of this problem.

5. Adequacy of the dietary in comparison with AR 40-250.

Food consumed from mess alone: The basic standards of the diet as prescribed in AR 40-250 (4) are 3600 calories and 100 gm. of protein for personnel who are physically active. If one considers these minimal allowances, then the total caloric intake of food consumed in the mess is low by both the inventory and "by weight difference" methods (3377 and 3446 calories) even though the protein intake is adequate; but it must be appreciated that this intake is voluntary since 792 and 767 calories are available in the form of discarded plate and kitchen losses by the weight difference and inventory methods.

Relationship of calories consumed in the mess to calories consumed outside the mess: As mentioned in previous studies (1, 2, 3) by this laboratory, a considerable amount of food is consumed by the troops in facilities outside the mess. This is a normal procedure regardless of the food preparation in the regular mess and may be attributed to a form of social eating and relaxation. The total calories consumed outside the mess averaged 731 calories PMPD which was 17.6% of the total food consumption from all sources, by the inventory method, 17.3% by the "by weight difference" method and 18.4% by bomb calorimetry. When one considers the total food consumption from all sources by the various methods, then the intake was adequate and above the basic minimal requirements of 3600 calories as stated in AR 40-250 (4).

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TABLE I

Fort Benning, Ga., Company "G" Airborne Training Bn.

Disposition of Food Calories as Determined by Analysis of Composite Samples

Carbohydrate Determined as Reducing Sugar and by Difference

Food Composite Sample

Carbohydrate Determined as Reducing Sugar	1st Cycle	2nd Cycle	Weighted Ave.
1. Food as served on tray	3289	3373	3331
2. Plate loss and tray wash*	229	221	225
3. Consumed in between meals at mess	40	42	41
4. Total consumed in mess (1-2+3)	3100	3193	3147
5. Kitchen loss	192	158	175
6. Rendered Fat	270	297	284
7. Grease Trap Skimmings	50	50	50
8. Potentially edible food in mess (2+4+5+6+7)	3841	3920	3881

Carbohydrate Determined by Weight Difference Method	1st Cycle	2nd Cycle	Weighted Ave.
1. Food as served on tray	3614	3697	3651
2. Plate loss and tray wash*	250	242	246
3. Consumed in between meals at mess	40	42	41
4. Total consumed in mess (1-2+3)	3404	3497	3446
5. Kitchen loss	230	197	212
6. Rendered Fat	270	297	284
7. Grease Trap Skimmings	50	50	50
8. Potentially edible food in mess (2+4+5+6+7)	4204	4283	4238

*An average tray wash loss of 15 calories PMPD was assumed, based upon the data of three previous surveys.

TABLE II

Fort Benning, Ga., Company "G" Airborne Training Bn.

Disposition of Protein as Determined by Chemical Method
Grams Per Man Per Day

Food Composite Sample	1st Cycle	2nd Cycle	Weighted Ave.
1. Food as served on tray	110.8	122.4	116.8
2. Plate loss and tray wash	7.3	7.9	7.6
3. Consumed in between meals at mess	2.0	2.1	2.0
4. Total consumed in mess (1-2+3)	105.5	116.6	111.2
5. Kitchen loss	6.2	4.7	5.4
6. Rendered fat	---	---	---
7. Grease trap skimmings	---	---	---
8. Potentially edible food in mess (2+4+5)	119.0	129.2	124.2

TABLE III

Fort Benning, Ga., Company "G" Airborne Training Bn.

Disposition of Fat as Determined by Chemical Method
Grams Per Man Per Day

Food Composite Sample	1st Cycle	2nd Cycle	Weighted Ave.
1. Food as served on tray	188.8	177.7	183.2
2. Plate loss and tray wash	15.8	14.7	15.2
3. Consumed in between meals at mess	2.0	2.2	2.1
4. Total consumed in mess (1-2+3)	175.0	165.2	170.1
5. Kitchen loss	12.4	9.5	10.9
6. Rendered fat	30.7	33.0	31.8
7. Grease trap skimmings	5.6	5.6	5.6
8. Potentially edible food in mess (2+4+5+6+7)	239.5	228.0	233.6

TABLE IV

Fort Benning, Ga., Company "G" Airborne Training Bn.

Disposition of Carbohydrate as Determined as Reducing Sugar and the Carbohydrate by Weight Difference Method
Grams Per Man Per Day

Food Composite Sample

Chemical Method as Reducing Sugar	1st Cycle	2nd Cycle	Weighted Ave.
1. Food as served on tray	286.1	322.8	304.5
2. Plate loss and tray wash	14.3	16.2	15.4
3. Consumed in between meals at mess	3.5	3.7	3.6
4. Total consumed in mess (1-2+3)	275.3	310.3	292.7
5. Kitchen loss	17.0	13.4	15.2
6. Rendered fat	---	---	---
7. Grease trap skimmings	---	---	---
8. Potentially edible food in mess (2+4+5)	306.6	339.9	323.3
Carbohydrate Determined by Weight Difference			
1. Food as served on tray	368.0	405.4	384.7
2. Plate loss and tray wash	19.6	22.0	20.7
3. Consumed in between meals at mess	3.5	3.7	3.6
4. Total consumed in mess (1-2+3)	351.9	386.2	367.6
5. Kitchen loss	21.1	20.1	20.7
6. Potentially edible food in mess (2+4+5)	392.6	428.3	409.0

TABLE V

Fort Bonning, Ga., Company "G" Airborne Training Bn.

Total Edible Portion* From Mess Alone by the Various Methods

Method - Calories PMPD	1st Cycle	2nd Cycle	Average
Chemical, (CHO as reducing sugar)	3841	3920	3881
Carbohydrate by weight difference	4204	4283	4238
Inventory, MNL observed refuse data	4117	4180	4144
Inventory, USDA data for refuse	4161	4202	4176
Bomb calorimetry	3958	4124	4042
Protein - Grams PMPD			
Chemical	119.0	129.2	124.2
Inventory, MNL observed refuse data	127.0	133.6	130.6
Inventory, USDA data for refuse	129.3	134.6	132.0
Fat - Grams PMPD			
Chemical	239.5	228.0	233.6
Inventory, MNL observed refuse data	203.8	198.5	207.0
Inventory, USDA data for refuse	217.0	200.0	209.4
Carbohydrate - Grams PMPD			
Chemical (as reducing sugar)	306.6	339.9	323.3
By weight difference	392.6	428.3	409.0
Inventory, MNL observed refuse data	432.4	478.6	452.5
Inventory, USDA data for refuse	435.2	480.8	454.5

*Also called the "as prepared" portion.

TABLE VI

Fort Benning, Ga., Company "C" Airborne Training Bn.

Disposition of Food Calories and Nutrients by the Long Inventory Method

Calories PMPD	1st Cycle	2nd Cycle	Average
1. Calories Consumed in Mess	3318	3436	3377
2. Total edible portion "as prepared"	4117	4180	4144
3. Total losses	799	744	767
4. Food Consumed Outside Mess	653	778	731
5. Total Consumption from all Sources	3971	4214	4108

Nutrients Grams PMPD	1st Cycle	2nd Cycle	Average
1. Protein Consumed in Mess	110.5	120.0	115.3
2. Fat Consumed in Mess	150.8	144.0	147.4
3. Carbohydrate Consumed in Mess	371.4	427.9	395.5

TABLE VII

Fort Benning, Ga., Company "G" Airborne Training Bn.

Bomb Calorimetry (1) Calories Consumed in Mess at Meals, PMPD

	1st Cycle	2nd Cycle	Weighted Ave.
Actual Bomb Calorimetry Data	3456	3643	3549
Correction for Protein (2)	170.8	188.9	180.2
Correction for Fat (2)	77.9	73.4	75.6
Correction for Carbohydrate (2)	27.2	30.7	28.9
Correction for Crude Fiber	54.3	55.5	54.9
Total Correction for all	330.2	348.5	339.6
Corrected Bomb Calorimetry Data	3126	3294	3209

(1) Corrected data, using Atwater's data, pages 134-135, H. C. Sherman, Chemistry of Food and Nutrition, 7th edition 1946, MacMillan Co., N.Y.

(2) Using factor of 5.65 for protein, 9.45 for fat and 4.1 for carbohydrate. Actual heat of combustion when undergoing complete oxidation in the bomb calorimeter (See appendix for calculation).

TABLE VIII

Fort Benning, Ga., Company "G" Airborne Training Bn.

Food Eaten Between Meals at Mess and Food Eaten Outside Mess, PMPD

Food Eaten Outside Mess (Calculated from Standard Food Tables)

1st Cycle	Calories	Protein, gm.	Fat, gm.	Carbohydrate, gm.
1st Week	774	17.3	32.1	99.9
2nd Week	664	13.5	28.3	85.8
3rd Week	523	10.0	22.6	68.0
Average	653	13.6	27.7	84.6
2nd Cycle				
1st Week	1004	27.0	43.4	118.0
2nd & 3rd Week	665	14.4	29.7	85.5
Average	778	18.6	34.3	96.3
Average for 2 cycles	731	16.5	31.0	92.1

Food Eaten Between Meals at Mess (Calculated from Standard Food Tables)

	Calories	Protein, gm.	Fat, gm.	Carbohydrate, gm.
1st Cycle	39.5	2.0	2.0	3.5
2nd Cycle	42.1	2.1	2.2	3.7
Average for 2 cycles	40.8	2.05	2.10	3.60

TABLE IX

Fort Benning, Ga., Company "C" Airborne Training Bn.

Total Consumption of Food From All Sources

Calories Average PMPD	Direct Method Reducing Sugar Chemical Method	Inventory Method	Bomb Calorimetry	Carbohydrate by Wt. Diff. Chemical Method
Food consumed in mess at meals	3106	3377	3209	3405
Food in between meals at mess	41	41	41	41
Food consumed outside mess	731	731	731	731
Total food consumption, all sources	3878	4149	3981	4238
Protein Grams PMPD				
Food consumed in mess at meals	109.2	116.3	---	---
Food in between meals at mess	2.0	2.0	---	---
Food consumed outside mess	16.5	16.5	---	---
Total food consumption, all sources	127.7	133.8	---	---
Fat Grams PMPD				
Food consumed in mess at meals	168.0	147.4	---	---
Food in between meals at mess	2.1	2.1	---	---
Food consumed outside mess	31.0	31.0	---	---
Total food consumption, all sources	201.1	180.5	---	---
Carbohydrate Grams PMPD				
Food consumed in mess at meals	289.1	395.5	---	364.0
Food in between meals at mess	3.6	3.6	---	3.6
Food consumed outside mess	92.1	92.1	---	92.1
Total food consumption, all sources	384.8	491.2		459.7

TABLE X

Fort Benning, Ga., Company "G" Airborne Training Bn.

Calculation of Carbohydrate by Weight Difference
Grams PMPD

	1st Cycle	2nd Cycle	Average
Food as Served on Tray			
Composite weight	3079.7	3155.2	
Grams Percent Protein	3.62	3.87	3.74
" " Fat	6.11	5.59	5.85
" " Crude Fiber	0.30	0.30	0.30
" " Ash	0.45	0.45	0.45
Total	10.48	10.21	10.34
Percent total solids	22.43	23.06	22.68
Grams % Carbohydrate by weight difference	11.95	12.85	12.34
On tray Carbohydrate by weight difference, grams	368.0	405.4	384.7
Plate loss			
Composite weight, gm. per day	44853	36399	40626
Grams Percent Protein	5.52	5.53	5.52
" " Fat	10.62	9.11	9.88
" " Crude Fiber	0.30	0.30	0.30
" " Ash	0.45	0.45	0.45
Total	16.92	15.39	16.15
Grams Percent Total Solids	30.94	30.53	30.73
Grams percent Carbohydrate by weight difference	14.02	15.14	14.58
Average Head Count	321	251	286
Plate loss, Carbohydrate by weight difference, grams	19.6	22.0	20.7
Consumed Carbohydrate by weight difference, grams	348.4	382.5	364.0

TABLE XI

Fort Benning, Ga., Company "G" Airborne Training Bn.

Edible Food Loss, Pounds PMPD and Calories per Gram
(Weight Difference Method)

	Calories	Pounds PMPD	Grams PMPD	Calories per gram
Plate loss	246	0.233	106	2.32
Kitchen loss*	546	0.246	112	4.87
Total loss	792	0.479	224	3.53

*Kitchen loss includes rendered fat drippings and grease trap skimmings

TABLE XII

Fort Benning, Ga., Company "G" Airborne Training Bn.

Percent of Nutrients in Food Losses, Average for Two Cycles

Total Edible Food Losses	Calories	Percent of Total			Percent of total edible portion
Method	PMPD	Protein	Fat	Carbohydrate	
Chemical, reducing sugar	734	7.0	76.6	16.4	18.9
Chemical by weight difference	792	6.6	72.4	21.0	18.7
Inventory	767	27.1	65.5	7.2	18.5

Percent Distribution of the Various Food Losses

	By Weight Difference		Direct Chemical		Inventory	
	Calories	Percent of total	Calories	Percent of total	Calories	Percent of Total
Total Food Loss	792		734		767	
Plate	246	31.1	225	30.7	217	28.3
Kitchen	212	26.8	175	23.8	216	28.2
Rendered Fat	284	35.9	284	38.7	284	37.0
Grease Trap	50	6.1	50	6.8	50	6.5

TABLE XIII

Fort Benning, Ga., Company "G" Airborne Training Bn.

Percent Distribution of Calories, Average for Two Cycles

	Total Calories PMPD	Percent Protein	Fat	Carbohydrate
Total Edible Portion, Mess Alone Method				
Chemical, Reducing Sugar	3881	12.5	54.2	33.3
Chemical, Carbohydrate by weight difference	4238	11.7	49.6	38.6
Inventory	4144	12.5	44.4	43.1
Total Edible Portion, All Sources Method				
Chemical, Reducing Sugar	4612	12.2	51.7	36.1
Chemical, Carbohydrate by weight difference	4961	11.4	48.1	40.5
Inventory	4895	11.9	43.7	44.4
Total Consumption, Mess Alone Method				
Chemical, Reducing Sugar	3147	13.9	48.8	37.3
Chemical, Carbohydrate by weight difference	3446	12.9	44.4	42.7
Inventory	3377	13.7	39.4	46.9
Total Consumption, All Sources Method				
Chemical, Reducing Sugar	3878	13.2	46.9	39.9
Chemical, Carbohydrate by weight difference	4238	12.3	43.6	44.1
Inventory	4108	12.9	39.3	47.8

Fort Benning, Ga., Company "G" Airborne Training Bn.

APPENDIX I

LONG INVENTORY METHOD USING RECIPES*

Outline of Operation:

1. A certain period, usually a week to ten days, is decided upon. This period should cover the normal series of events at the mess.

2. The evening before the survey is to start, a complete inventory is made of all food items in the mess and stockroom. The number of cans or boxes of each food item is recorded along with the weight of the can or box. Items that are bought in bulk are weighed, and recorded. Any left over prepared food items must also be weighed and recorded.

3. During this preliminary period it is also helpful to tare all of the pans that are used in the mess and mark them with either metal dies or heat resistant, fat insoluble, water resistant ink.** This practice eliminates the continuous weighing of empty pans during the survey period.

4. In order to check the utilization of food and, also, to provide the necessary data needed to convert cooked plate and kitchen loss to raw food equivalents when calculating food intake, it is necessary to take recipes during the survey. (See examples 1 and 2 in Appendix II). These recipes must contain the following data: the before and after cooking weight of each food item used in the recipe, and the fat drippings which are not served. Fat drippings of meats which are used on other recipes must be recorded as an ingredient of the recipe.

5. A record of the number of people that eat in the mess must be kept for each meal.

6. A record must be kept of all the food that is eaten in the mess at times other than at mealtime; also, any food items that are used for other purposes besides that of serviceable food; for example, the use of lemons as a floor cleaning agent.

7. After the last meal of the survey, a final inventory is taken. This must be carefully done in order to insure that all food items present in the mess are accounted for. Care must be taken that a record of all left over items is made. From the records that have been taken it is possible to calculate the amounts of food that were not eaten.

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* The difference between inventory method MNL and inventory method using USDA tables is that in the MNL actual observed preparation wastes are used; in the USDA method, the average values which have been assigned in the tables have been used.

**Purchased at the Palo Laboratory Supply, Inc., 81 Reade Street, New York 7, New York

8. During the survey period the grease trap skimmings are weighed, recorded and analyzed chemically for fat. In this way the fat left in cooking and serving pans can be accounted for. Analysis of the tray wash water is also made in order to determine the loss of fat on the trays.

9. During the survey period all of the plate loss is collected by food item, weighed and recorded and saved for chemical analysis. In cases where this is not possible (potatoes and gravy, dressing and salad), chemical analysis can be made in order to obtain the ratio of each item in the mixture. In addition the inedible material is separated from the edible portion, bones from the meat, and peelings, cores, and pits from fruit. The inedible material is weighed, recorded and discarded.

10. After completion of the survey and before the final calculation of intake can be made, the following calculations are computed:

a. Conversion of all plate and kitchen loss to the raw equivalents.

b. Calculation of the fat drippings not used (Total fat drippings minus the fat drippings used).

The total fat drippings not used must be subtracted from the total amount of fat or it can be converted to calories and subtracted from the final calorie figure. This correction is necessary since the calculation of intake, using the amounts of raw food utilized, will include this amount of fat that is derived from meats during the cooking process.

c. Computation of the average head count. The daily head count for the whole survey period is taken. One need only divide the total head count for the total survey period by three (a man day is equal to three meals) in order to obtain the head count factor that will give PMPD values. Dividing the total amount of any food item by this factor will give PMPD amount for this particular item.

11. The "as prepared" or total weight of food that is prepared for consumption can be calculated by totalling the amounts of each food item; all of the milk used, all potatoes prepared, etc. These weights can be obtained by merely subtracting the food item found in the final inventory from the sum of the initial inventory and the daily issues. As these weights are in raw "as purchased" values, they can be converted to calories, fat, protein, and carbohydrate by use of Table 2, Department of Agriculture Handbook No. 8 (14). This table presents values for the composition of the edible portion of foods expressed in terms of per pound of the food as purchased. The correction for preparation loss is made automatically by use of this table. The total values for each food item can then be converted to a PMPD basis by dividing by the head count factor (paragraph 10 c.).

12. In order to calculate the actual food intake a number of corrections must be made. After the amount of each food item used is determined (paragraph 11), the figure must be corrected for preparation loss that is connected with that product; for example, the total weight of peelings that are pared from the

raw potatoes used during the survey period must be subtracted from the total amount of raw potatoes utilized. Some products are normally served with some edible loss (bones in certain types of meat) which must be subtracted from the product after serving. In cases where the total amount of a cooked food item is not served, the unserved portion is converted to the raw equivalent and subtracted from the total prepared. The correction for such items as bones, then, is only needed for the amount of the food item served. Following the correction for preparation loss, the remaining edible portion is further corrected for kitchen loss, plate loss, and food eaten in between meals at the mess. However, kitchen and plate loss must also be converted to raw equivalents before they can be subtracted from the total edible portion. This can be done if complete information is kept on recipes for each food item prepared. From the cooking loss which includes both moisture loss and fat drippings, one can calculate the raw equivalent of each item either in the place or kitchen loss. The amount of fat drippings which are used in various products but which are not eaten must be accounted for (fat drippings in plate and kitchen loss). The fat drippings found in these two losses can be added to the weight of the fat drippings obtained but not used (paragraph 10 b.).

13. After correcting each food item served for the various losses, convert the remaining quantities to pounds PMPD by dividing the total pounds of food consumed by the head count factor (paragraph 10 c.). The pounds PMPD figures, after conversion to grams PMPD are entered in Table I, U. S. Department of Agriculture Handbook No. 8 (14); which presents the grams percent of fat, protein, carbohydrate, and calories for raw edible portions. These values have been printed in nutritional analysis booklets for use in calculating nutrient content of dietaries. After each food item has been converted into its composition in terms of fat, protein, carbohydrate, and calories, they are totaled for the whole survey period. The fat and calorie figures are further corrected by subtracting the calorie values of fat as found in the grease trap and tray wash sample. The fat drippings which were not used, in addition to those used but not eaten, are also converted to a PMPD basis, and the grams of fat and the calories in this fat are also subtracted (paragraphs 8, 10b and 12).

The final corrected figures for food consumption from the mess are presented in terms of calories, fat, protein, and carbohydrate.

Example of calculated recipe (1) APPENDIX I (cont'd)

RECIPE FOR Hot Biscuits DATE 18 November 1953

NUMBER OF SERVINGS

BREAKFAST DINNER SUPPER

INGREDIENT	PACKAGE SIZE	WEIGHT	NUMBER USED	TOTAL GRAMS	TOTAL POUNDS	% OF TOTAL	REMARKS
YEAST	40	880		840	1.85	4.0	
WATER					7.36	17.0	
SUGAR	320	900		580	1.28	3.0	
SALT	OZ	8			.50	1.0	
MILK COND	14½ OZ	.906	2		1.81	4.0	
SHORTENING	-	950			2.09	5.0	
FLOUR	6580	17810		11230	24.73	57.0	
" (biscuit rolling)							
LARD (grease pans)		1280			2.82	6.0	
BUTTER (on top biscuits)	LB		1		1.00	2.0	
					43.44		

Calculation to raw equivalent weight:

$$\frac{\text{Cooked Plate Waste } 200 \text{ gm}}{\text{Total After Cooking } 17900 \text{ gm}} \times 19720 \text{ (Total raw weight)} = \text{(Raw plate waste)} \quad 221\text{g}$$

WEIGHTS:

1.	BEFORE COOKING	4970	4940	4700	5180	5710	5610	3510	
	(a) GROSS	#91	#69	#103	#96	#97	#65	#93	
	(b) TARE	2290	1740	1750	2300	2270	2210	2340	
	(c) NET	2680	3200	2950	2880	3440	3400	1170	= 19720 gms
									= 43.44#
2.	FAT DRIPPINGS								
3.	AFTER COOKING								
	(a) GROSS	4650	4730	4420	4870	5420	5310	3400	
	(b) TARE	2290	1740	1750	2300	2270	2210	2340	
	(c) NET	2360	2990	2670	2570	3150	3100	1060	= 17900 gms
									= 39.43#
4.	COOKING LOSS	4.01#							
5.	PER CENT LOSS								

Example of calculated recipe (2) APPENDIX I (cont'd)

RECIPE FOR Potatoes - Hashed Brown DATE 20 November 1954

NUMBER OF SERVINGS

BREAKFAST DINNER SUPPER

INGREDIENT	PACKAGE SIZE	WEIGHT	NUMBER USED	TOTAL GRAMS	TOTAL POUNDS	% OF TOTAL	REMARKS
Potatoes - unpeeled	#107 6450	36350					
" peeled		27310		27310	60.15	91.0	
" peelings		9040					
Bacon grease	4630	7180		2550	5.61	9.0	
					65.76		

Calculation to raw equivalent weight:

Cooked Plate Waste 5090 gm / Total After Cooking 25636 gm x 29860 gm (total raw weight) = raw plate waste (5942 gm)

WEIGHTS:

1. BEFORE COOKING 20060 20100
   (a) GROSS # 85 # 122
   (b) TARE 5210 5090
   (c) NET 14850 / 15010 = 29860 gm. or 65.77#
2. FAT DRIPPINGS 6360 7000 # 85 #122 = 1150 / 1910 = 3060 gm. or 6.74#
3. AFTER COOKING 18220 17710
   (a) GROSS # 85 #122
   (b) TARE 5210 5090
   (c) NET 13010 / 12620 = 25636 gm. or 56.47 #
4. COOKING LOSS 9.30#
5. PER CENT LOSS

Example of calculated recipe (1) APPENDIX I (cont'd)

RECIPE FOR Hot Biscuits DATE 18 November 1953

NUMBER OF SERVINGS

BREAKFAST DINNER SUPPER

INGREDIENT	PACKAGE SIZE	WEIGHT	NUMBER USED	TOTAL GRAMS	TOTAL POUNDS	% OF TOTAL	REMARKS
YEAST	40	880		840	1.85	4.0	
WATER					7.36	17.0	
SUGAR	320	900		580	1.28	3.0	
SALT	OZ	8			.50	1.0	
MILK COND	14½ OZ	.906	2		1.81	4.0	
SHORTENING	-	950			2.09	5.0	
FLOUR	6580	17810		11230	24.73	57.0	
" (biscuit rolling)							
LARD (grease pans)		1280			2.82	6.0	
BUTTER (on top biscuits)	LB		1		1.00	2.0	
					43.44		

Calculation to raw equivalent weight:

$$\frac{\text{Cooked Plate Waste } 200 \text{ gm}}{\text{Total After Cooking } 17900 \text{ gm}} \times \underset{\text{(Total raw weight)}}{19720} = \underset{221\text{g}}{\text{(Raw plate waste)}}$$

WEIGHTS:

1.	BEFORE COOKING	4970	4940	4700	5180	5710	5610	3510	
	(a) GROSS	#91	#69	#103	#96	#97	#65	#93	
	(b) TARE	2290	1740	1750	2300	2270	2210	2340	
	(c) NET	2680	3200	2950	2880	3440	3400	1170	= 19720 gms
									= 43.44#
2.	FAT DRIPPINGS								
3.	AFTER COOKING								
	(a) GROSS	4650	4730	4420	4870	5420	5310	3400	
	(b) TARE	2290	1740	1750	2300	2270	2210	2340	
	(c) NET	2360	2990	2670	2570	3150	3100	1060	= 17900 gms
									= 39.43#
4.	COOKING LOSS	4.01#							
5.	PER CENT LOSS								

Example of calculated recipe (2) APPENDIX I (cont'd)

RECIPE FOR Potatoes - Hashed Brown DATE 20 November 1954

NUMBER OF SERVINGS

BREAKFAST DINNER SUPPER

INGREDIENT	PACKAGE SIZE	WEIGHT	NUMBER USED	TOTAL GRAMS	TOTAL POUNDS	% OF TOTAL	REMARKS
Potatoes - unpeeled	#107 6450	36350					
" peeled		27310		27310	60.15	91.0	
" peelings		9040					
Bacon grease	4630	7180		2550	5.61	9.0	
					65.76		

Calculation to raw equivalent weight:

$$\frac{\text{Cooked Plate Waste } 5090 \text{ gm}}{\text{Total After Cooking } 25636 \text{ gm}} \times 29860 \text{ gm (total raw weight)} = \text{raw plate waste } (5942 \text{ gm})$$

WEIGHTS:

1. BEFORE COOKING 20060 20100
   (a) GROSS # 85 # 122
   (b) TARE 5210 5090
   (c) NET 14850 / 15010 = 29860 gm. or 65.77#
2. FAT DRIPPINGS 6360 7000
   # 85 #122 = 1150 / 1910 = 3060 gm. or 6.74#
3. AFTER COOKING 18220 17710
   (a) GROSS # 85 #122
   (b) TARE 5210 5090
   (c) NET 13010 / 12620 = 25636 gm. or 56.47 #
4. COOKING LOSS 9.30#
5. PER CENT LOSS

Fort Benning, Ga., Company "G" Airborne Training Bn.

APPENDIX II

CORRECTION OF BOMB CALORIMETRY DATA USING ATWATER CORRECTIONS

Bomb calorimetry is the method used for the determination of the total caloric content of foods. However, the number of calories used by the body is less than the total caloric content found by the bomb due to excretion and, in the case of crude fiber, lack of absorption. Therefore, in order to use the data obtained from bomb calorimetry, certain corrections must be made.

The actual percentage of the caloric content of the food constituents used by the body is 98% of the carbohydrate calories, 95% of the fat calories and 92% of the protein calories. If one gram each of fat, protein and carbohydrate produce respectively 9.35, 5.65, and 4.1 calories using the bomb calorimeter, then the body uses 9, 4, 4 calories respectively.

The actual amount of fat and protein consumed can be determined by chemical analysis and, knowing this and the total caloric content, the carbohydrate fraction can be determined by difference as is shown below. Since crude fiber is not absorbed by the body but does contribute to the total caloric content as found by bomb calorimetry, it must be subtracted from the carbohydrate fraction. In the following example the precentage of crude fiber in food was determined to be 0.44 gms. per cent in the case of the "on tray" food and 0.41 gms. per cent in the case of the plate waste.

The calculation of the corrected caloric values is as follows:

Food composite weight = 2813 gm. PMPD
Gms. Percent crude fiber = 0.44

	Protein	Fat
Grams (Chemical analysis)	90.3	182.0
Factors	5.65	9.35
	510.2	1702.

Total protein and fat = 2212 calories

Total calories as determined by bomb calorimetry	3921
Less calories for protein and fat	2212
Calories in terms of carbohydrate	1709

Grams crude fiber = 0.44 x 2813 (sample wt.) = 12.38 gm.
Calories crude fiber 12 x 4.1 cal./gm. = 50.8

Carbohydrate	1709
Less crude fiber	51
Corrected carbohydrate	1658

$$\frac{\text{Gm. carbohydrate}}{\text{Bomb correction for carbohydrate}} \quad \frac{1658}{4.1} = 404.5 \text{ gm.}$$

Corrected gms. Fat 182.0 x 9	= 1638
Corrected gms. Protein 90.3 x 4	= 361
Corrected gms. carbohydrate 404.5 x 4	= 1619
Corrected calories	3618

Fort Benning, Ga., Company "G" Airborne Training Bn.

APPENDIX III

CARBOHYDRATE BY WEIGHT DIFFERENCE METHOD FOR COMPUTING FOOD CONSUMPTION

This method consists of computing the percent solids from the percent moisture, and then subtracting the combined total grams percent of protein, fat, crude fiber, and ash, as determined by the chemical analysis.

An example of the method of calculation is shown in the following table:

Total Weight of Food Composite		2903 grams
Grams percent by chemical analysis:		
Moisture		75.70
Protein		4.67
Fat		7.47
Crude Fiber		0.30
Ash		0.45
	TOTAL	12.89
	TOTAL PERCENT SOLIDS	24.30
Carbohydrate by weight difference		11.41
Multiplied by 2903		= 331.2 gm. of carbohydrate
	or	1324.8 calories

Fort Benning, Ga., Company "G" Airborne Training Bn.

APPENDIX IV

CALORIC AND NUTRIENT CONTENT OF FOOD ITEMS EATEN OUTSIDE THE MESS

FOOD ITEMS	UNIT	CAL-ORIES	PROT-EIN gms	FAT gms	CHO Gms	REFERENCE	
Soft drink bottles-coca-cola	6 oz.	86	---	---	21.6	USDA**	
Soft drink cups- ginger ale	8 oz.	80	---	---	21.0		
Beer glasses	8 oz.	115	1.3	10.0*	9.6	B&C***	Alcohol yields 7.1 cal/gm
Beer cans bottles	12 oz.	170	2.0	15.0*	13.6	B&C	
Fruit drink cups		102	1.1	0.4	25.0		
Whiskey shots	1 oz.	86	---	12.1*	---	B&C	
Wine glasses, based on port wine	2 oz.	98	0.2	9.0*	8.4	B&C	Note: Wine usually served in 2 oz. glasses
Wine pints	16 oz.	7811	1.6	72.0*	67.2	B&C	
Other drinks, fresh orange juice	6 oz.	72	---	---	18		
Milk fresh ½ pints	8 oz.	165	8.2	9.4	11.8	B&C	
Milk choc. ½ pints	8 oz.	185	8.0	5.5	26.5		
Shake or malted ave of choc shake & malted	351 g	442	12.4	19.8	53.6	B&C	
Ice cream bars	81 g	167	3.2	10.1	16.7	T.3 USDA	
Ice cream pints - vanilla	225 g or 1 pt	546	12.0	31.5	53.7	B&C	
Fresh fruit, apple, large	15 oz.	97	0.5	0.6	22.4	B&C	
Hamburgers		332	17.1	21.9	15.4		
Hot dogs		250	9.5	13.9	21.8	B&C	Calc. from meat, frank-furter & 2 soft rolls
Sandwiches, Ave of ham, rst beef & bacon, lettuce & tomato		255	816	14.8	21.7		
Eggs each	Med	79	6.4	5.8	0.4	B&C	
Sweet rolls	50 g	155	3.9	2.7	28.0	Bridges	
Doughnut		200	3.0	9.5	24.0	Bridges	
Cake piece		291	3.8	9.9	46.4		

FOOD ITEMS	UNIT	CAL-ORIES	PROT-EIN gms	FAT gms	CHO gms	REFERENCE	
Pie Slices - apple (6 slices to whole pie)		225	2.3	8.7	32.6	Bridges	
Cookies each (ave 24/box)	1 only	65	1.0	2.0	10.5	Bridges	
Crackers, saltine	2" sq	17	.4	.5	2.8	B&C	
Other pastry - jelly roll	50 g	210	2.4	9.5	27.7	Bridges	
Candy bars (Ave of 10 popular bars)	2 oz.	277	5.2	13.0	34.9	B&C	
Pop corn box or bag	1 cup 14 g	54	1.8	0.7	10.7	USDA**	
Nuts penny, roasted peanuts	16-17 15 g	89	4.0	6.6	3.5	B&C***	
Nuts 5¢ bag	30 nuts 60 g	360	16.9	29.4	5.1	Bridges	
Nuts ¼ lb - cashew	8 med	92	2.9	7.1	4.0	B&C	
Roast beef sandwich		212	11.6	8.4	22.0	B&C	
Ham sandwich		225	9.4	11.9	20.3	B&C	
Bacon lettuce & tomato sandwich		329	4.9	24.2	22.8	B&C	
Crackers, cheese	2" dia	22	0.8	0.8	2.9	B&C	
Steak sandwich		536	31.6	33.8	23.8		
Grilled cheese sandwich		239					
Bacon sandwich		273	9.4	14.9	12.4		
Fig bars each (16 gms)	box 16 g	54	.6	1.1	10.5	B&C	
Ice cream sundae		580	10.0	31.0	57.0		
Orange - med lg		76	1.4	.3	16.8	B&C	
Raisins 3/4 cup		298	2.3	.5	71.2	B&C	
Pear - med.		70	.7	.4	15.8	B&C	
Banana		299	3.6	.5	69.9	B&C	
Whole meals (average)		1000	35.0	45.0	115		
Nothing Eaten							

* Alcohol yields 7.1 calories/gm
** USDA Handbook #8
*** B&C - Bowes and Church

Fort Benning, Ga., Company "G" Airborne Training Bn.

APPENDIX IV

CALCULATION OF FOOD EATEN OUTSIDE THE MESS
EXAMPLE

FOOD ITEMS -	TOTAL NO. ITEMS TALLIED	CALORIES	PROTEIN GRAMS	FAT GRAMS	CHO GRAMS	ALCOHOL	
Soft drink bottles	105	9030	---	---	2268.0		
Soft drink cups	92	7360			1932.0		
Beer glasses	236	27140	306.8	---	2265.6	2360	
Beer cans bottles	390	66300	780.0	---	5304.0	5850	
Fruit drink cups	73	7446	80.3	29.2	1825.0		
Whiskey shots	90	7740	---	---	---	1089.0	
Wine glasses	14	1372	2.8	---	117.6	126.0	
Wine pints	6	4704	9.6	---	403.2	432.0	
Other drinks	38	2736	---	---	68.1		
Milk fresh ½ pints	305	50325	2501.0	2867.0	3599.0		
Milk choc. ½ pints	204	37740	1632.0	1122.0	5406.0		
Shake or malted	157	69394	1946.8	3108.6	8415.2		
Ice cream bars	144	24048	460.8	1454.4	2404.8		
Ice cream pints	336	183456	4032.0	10584.0	18043.2		
Fresh fruits	54	5238	27.0	32.4	1209.6		
Hamburgers	110	36520	1881.0	2409.0	1694.0		
Hot dogs	156	39000	1482.0	2168.4	3400.8		
Sandwiches	133	33915	1143.8	1968.4	2286.1		
Eggs each	56	4424	358.4	324.8	22.4		
Sweet rolls	109	16895	425.1	294.3	3052.0		
Doughnut	204	40800	612.0	1938.0	4896.0		
Cake piece	167	48597	634.6	1653.3	7748.8		
Pie slices	188	42300	432.4	1635.6	8128.8		
Cookies each	953	61945	953.0	1906.0	10006.5		
Crackers	24	408	9.6	12.0	67.2		
Other pastry	129	27090	309.6	1225.5	3573.3		

FOOD ITEMS	TOTAL NO. ITEMS TALLIED	CALORIES	PROTEIN GRAMS	FAT GRAMS	CHO GRAMS	ALCOHOL	
Candy bars	1388	384476	7217.6	18044.0	48441.2		
Pop corn box or bag	79	4266	142.2	55.3	845.3		
Nuts penny	41	3649	164.0	270.6	143.5		
Nuts 5¢ bag	20	7200	338.0	588.0	102.0		
Nuts 1/4 pound	25	2300	72.5	177.5	100.0		
Whole meals	337	337000	11795.0	15165.0	38755.0		
TOTAL		1594814	39749.9	69033.7	165124.5		

No. of Days - 10

Head Count -250

1.	Average/man/no. days survey	6379	158.9	276.1	740.5
2.	Average/man/day	638	15.9	27.6	74.1

Fort Benning, Ga., Company "G" Airborne Training Bn.

APPENDIX V

ASSIGNMENT OF DUTIES TO MEMBERS OF THE SURVEY TEAM

1. Inventory long method.

a. In each mess prior to the start of a survey period (after supper of the day before) a complete inventory of all food items on hand is taken. This will include all food items in the storage room, refrigerator, vegetable racks, bread and cake storage racks and all items on the mess tables. All non-packaged or non-canned items and all left-overs must be weighed and recorded. Check for weight of rendered fat container which is usually hidden.

b. During the course of the survey a complete record of all weights of the daily food issues are maintained and duplicate issue slips will be supplied to the survey team by the Post Food Service Division. These items must be weighed by the survey team, because shortages occur quite frequently.

c. At the end of the survey period (after supper on the last day) a complete inventory is again made of all food items on hand. Reweigh fat dripping container.

2. Marking of pans.

On the evening prior to the start of the survey all the pots and pans are marked. All the black pans which include 50 and 100 ration pans, baking sheet and square pans etc. are numbered with a stamping die, weighed and recorded. All other pots and pans are weighed and the weights are stamped on the sides of the container with heat resistant, water and fat insoluble marking ink. (Caution the KP's about using steel wool to rub off the ink markings). The ink usually lasts till the end of the survey. The marking procedure simplifies the need for weighing the empty pan each time.

3. Chief of survey team.

a. General supervision of all phases of survey techniques.

b. All preliminary plans at Post to be surveyed.

c. See Food Service Division and obtain duplicate issue sheets each day.

d. Gather together all mess personnel and explain problem.

e. Survey mess facilities.

f. Call a meeting of the trainees and explain the questionnaire for food eaten outside mess.

4. Grease trap skimmings.

Clean and discard the grease trap skimmings on the early morning of the first day of the survey. The skimmings are from the previous day. On each of the following mornings, skim, weigh and save an aliquot for analysis. This procedure must be performed before the kitchen personnel begin to wash their equipment in the morning. (alternate personnel).

5. Preparation loss.

All the inedible preparation loss which includes items such as egg shells, bones, pits, rinds and vegetable trimmings must be weighed, recorded and discarded.

6. Recipe takers.

Collection of all recipe data (using recipe sheets) from all prepared food items. Personnel must be present when kitchen opens each morning. (alternate personnel). Recipe recorders must watch main kitchen, bakery and vegetable preparation areas at all times when mess personnel are preparing food items. Items to be recorded will include (a) the raw weight of the individual food items of the recipe, (b) the total raw weight before cooking, (c) the total cooked weight after cooking and (d) the weight of the fat drippings, if any. Collect and record individual weights of all kitchen loss and rendered fat dripping. (Rendered fat drippings are weighed and recorded on a weekly basis).

7. Head count.

Record head count for each meal and be sure to include mess personnel and all others who eat. Don't count personnel who come back for seconds.

8. Food on mess tables.

Weigh and record all food items on the mess tables both before and after meals. These items usually include sugar, evaporated milk, jams etc., and must be included in the food composite. It's a good idea to keep in contact with the KP who fills the sugar bowls.

9. Collection of individual food items for composite samples.

In making up the food composite of the food as served on the tray, five average servings of each food item served on the line must be collected at different intervals during the course of the meal. These items must be weighed and subtracted from the food as served on the line, otherwise they will be charged as eaten by the trainees.

10. Plate scrapings.

Setting up of the plate scraping line. In some convenient location set up at least one large container for each food item. Be sure that all food items are segregated by item and recorded on waste sheets, after all trainees have finished eating. Save for composite plate loss at the end of day. All bones, rinds, and pits must be separated, weighed and discarded as preparation waste.

11. Tray wash water.

Record volume of tray washing water, mix and collect a sample for analysis after each meal.

12. Calculation of average food items taken per man.

From the meal sheets (see Appendix VII) calculate the average food item per man as taken on the tray and make up the food composite after each meal.

13. In-between meal eating at mess.

Weigh and record all the food eaten between meals by the mess personnel, NCO's etc., especially during coffee breaks. This usually amounts to a considerable amount of food during the course of a day.

14. Preparation of food composites for analysis.

After the last meal each day, calculate the food composite and make up the sample. Combine the composites for the three meals, homogenize in a Waring blender, mix and save two aliquots (8 oz. btls) for analysis.

15. Preparation of plate and kitchen loss composite.

At the end of the day, weigh separately the total kitchen and plate losses for the day and record on waste sheets (Appendix VIII). Grind with a large Hobart grinder, mix well using a paddle, and take out an aliquot. The aliquot is then homogenized in a Waring Blendor, mixed and samples saved for analysis.

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APPENDIX VI

THE CORRECTION OF GROSS BOMB CALORIMETRY ENERGY TO NET METABOLIZABLE ENERGY

The bomb method as now used (using Atwater correction), represents still another method of calculating carbohydrate, this by difference from the bomb calorimeter data rather than by difference from weight data. To make such a calculation we must assume (a) that 6.25 x N is an accurate estimate of true protein, (b) that 5.65, 9.45 and 4.1 are accurate estimates of average bomb values of pure ingredients, (c) that 1.30 is an accurate estimate of urine calories per gram loss of protein ingested and, (d) that essentially all of the gross energy is contained in protein, fat (by chem.) and CHO (by weight difference). These assumptions are unwarranted and one is bound to get a distorted figure.

The following are two types of calculation using bomb calorimetry data:

Food Consumed in Mess

I.	Gross bomb calories	3549
	Protein bomb calories	109.2
	Fat bomb calories	168.0
	Carbohydrate (by weight difference)	364.0

109.2 x 5.65 = 617 cal.
168.0 x 9.45 = 1588
364.0 x 4.1 = 1492
3697 = calculated gross energy value by chemical methods.

Then the calculated gross energy by the chemical method and carbohydrate by weight difference is 152 calories of 4.3 per cent higher than the bomb. If the chemical method overestimates gross energy, presumably net energy would also be overestimated.

II. Correction of gross bomb energy to net metabolizable energy.

Correction 1. Energy cost in urine due to incomplete combustion of protein = 1.30 calories per gram of protein.

Correction 2. Energy lost in feces is equal to undigestible material and incompletely digested material and endogenous material. This is estimated as an average of 4.10 per cent of the gross calories in food ingested on the basis of the Atwater data.

a)	Gross energy in food consumed at mess	3549 calories
b)	Correction for protein loss in urine	142 calories
c)	Correction for fecal loss (4 per cent of gross energy)	145 calories
	Net energy	3262 calories

Although this gives a value very similar to the one found using the Atwater correction for nutrients (3209), it avoids some unwarranted assumptions.

Fort Benning, Ga., Company "G" Airborne Training Bn.

APPENDIX VII

SURVEY Co. G Abn. Trng. Bn. Ft Benning, Ga. INDIVIDUAL FOOD ANALYSIS CO BEN 1144

BREAKFAST DINNER SUPPER A

DATE _____ DAY OF SURVEY 5 HEAD COUNT 301

B FOOD ITEM	C WT. EMPTY PAN	D WT. FULL PAN	E WT. FOOD OFF-ERED	F WT. PAN AFTER SERV-ING	G WT. FOOD TAKEN	H NO. TAKING ITEM	I FOOD TAKEN PER MAN	J NO OF SERV-ING	K TARE	L GROSS	M NET	N AVE. SERV-ING	O LEFT OVERS DISPO-SITION OF
BEEF POT ROAST	1770	12740		1770									
	1770	10560		1770									
	1770	10400		1770									1
	5310	33700	28390	5310	28390		94.3						
L.O. BUTTER	720	2540		720									
		1816		280									2
	720	4356	3636	1000	3356		11.1						
FRUIT COCKTAIL	4470	30440		4470									
	4330	26700		4330									1
	8800	57140	48340	8800	48340		160.6						
LETTUCE	4500	8780		4500									1
	4500	8780	4280	4500	4280		14.2						
TOTAL WEIGHT							280.2						

*Key to Left Over Food

1. None 2. Stock 3. Kitchen Waste
4. Rendered Fat

Fort Benning, Ga., Company "G" Airborne Training Bn.

APPENDIX VIII

INDIVIDUAL WASTE ANALYSIS

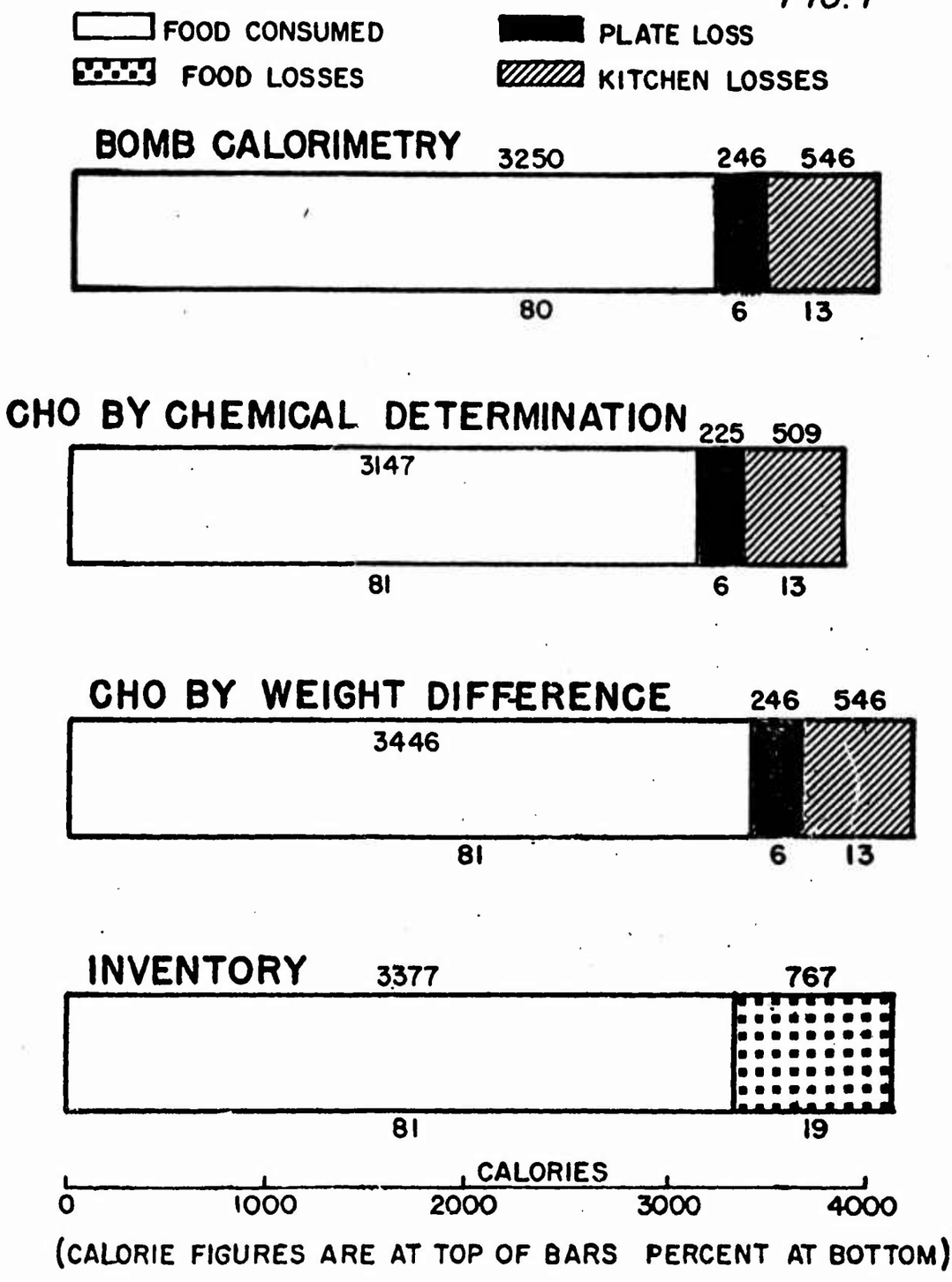
SURVEY Fort Benning, Ga. Co. G. Abn Trng. Bn. Circle Meal - BREAKFAST DINNER SUPPER

DATE 16 Nov 53 DAY OF SURVEY 5

WASTE	PLATE SAMPLE 2			KITCHEN SAMPLE 3			PREPARATION SAMPLE 4			TOTALS
	TARE	GROSS	NET WT.	TARE	GROSS	NET WT.	TARE	GROSS	NET WT.	
CELERY (BEEF PROCESSING)				---	---	2180				
LETTUCE TRIMMINGS (SALAD)							930	1690	760	
LETTUCE TRIMMINGS (ISSUE)							690	4460	3770	
BEEF TRIMMINGS							1590	2000	410	
GRAVY (SPILLED)				950	1670	720				
GRAVY				1450	3370	1920				
ONION TRIMMINGS							660	1500	840	
ONION (BEEF PROCESSING)				930	3560	2630				
BEEF POT ROAST	250	1750	1500							
BREAD	750	1220	470							
FRUIT SALAD	750	4670	3920							
NOODLES	750	7110	6360							
BUTTER	250	560	310							
TOTAL PER MEAL			12560			5230				

DISPOSITION OF FOOD CALORIES FROM MESS ALONE AT FT. BENNING, CO. G, AIRBORNE TRAINING BATTALION, BY VARIOUS METHODS

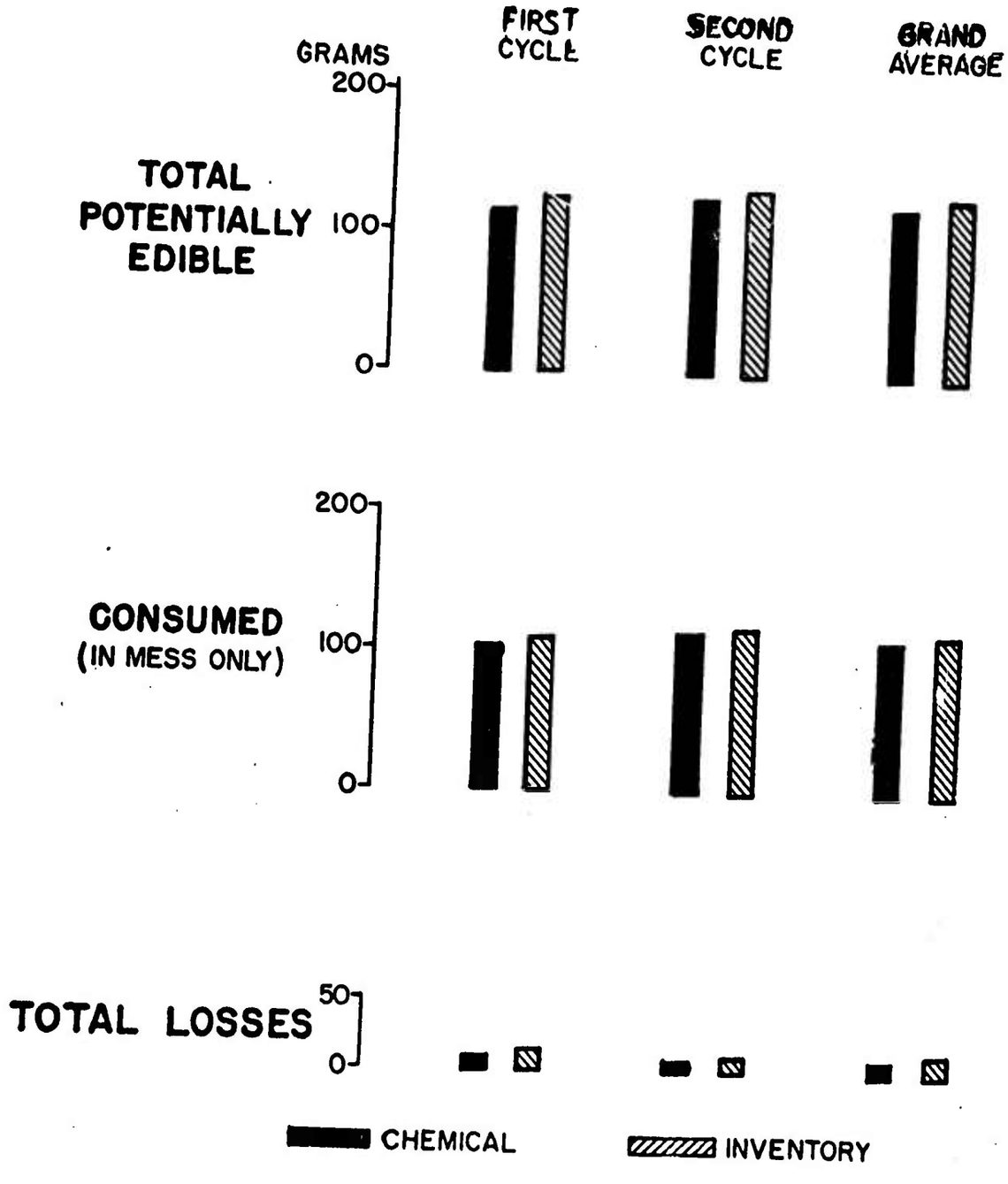
FIG. 1



(CALORIE FIGURES ARE AT TOP OF BARS PERCENT AT BOTTOM)

DISPOSITION OF FOOD PROTFIN IN TWO TRAINING CYCLES AT FT. BENNING, GA.

FIG. 2



DISPOSITION OF FOOD FAT IN TWO TRAINING CYCLES AT FT. BENNING, GA.

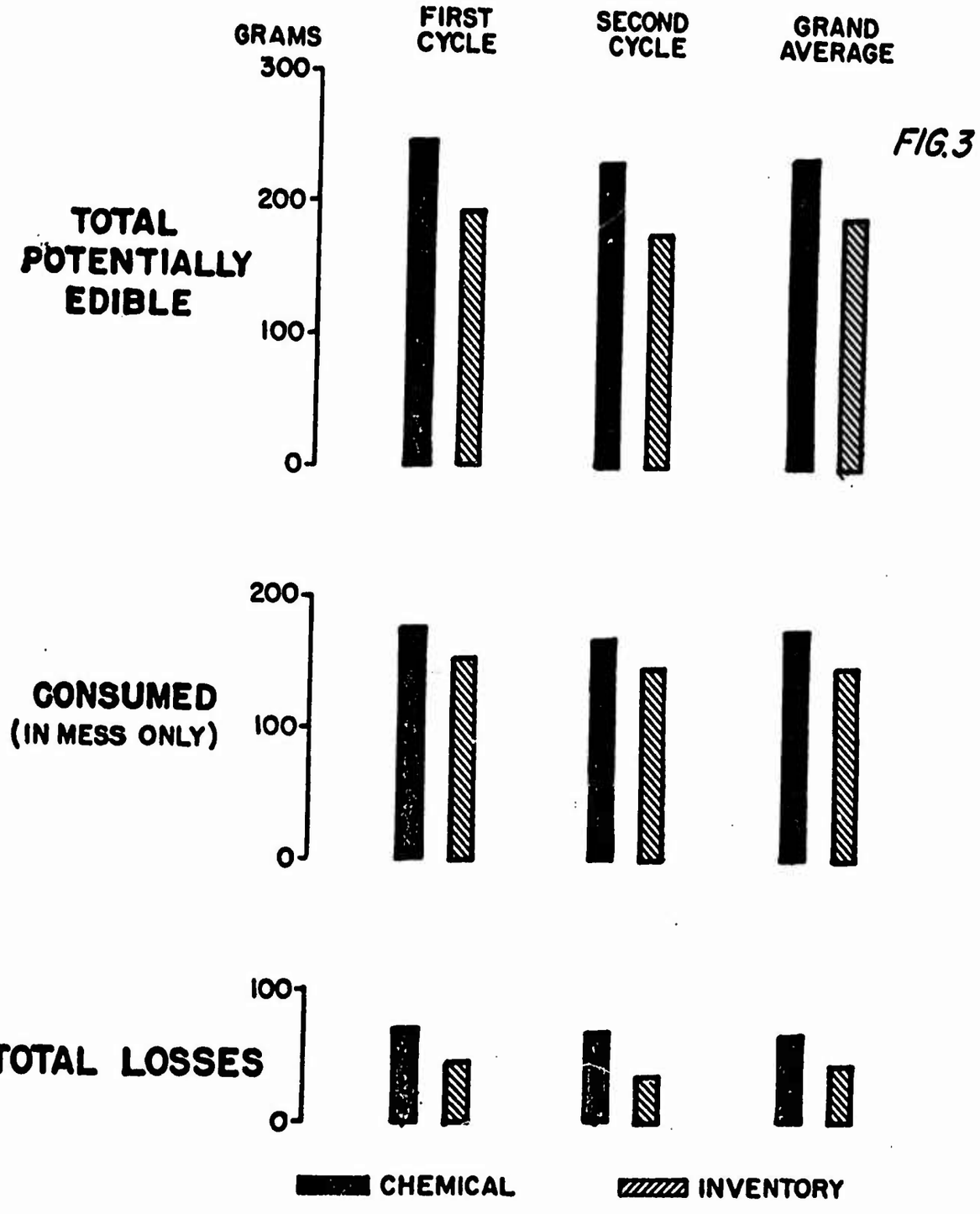


FIG. 3

DISPOSITION OF FOOD CHO IN TWO TRAINING CYCLES AT FT. BENNING, GA. BY VARIOUS METHODS

FIG. 4

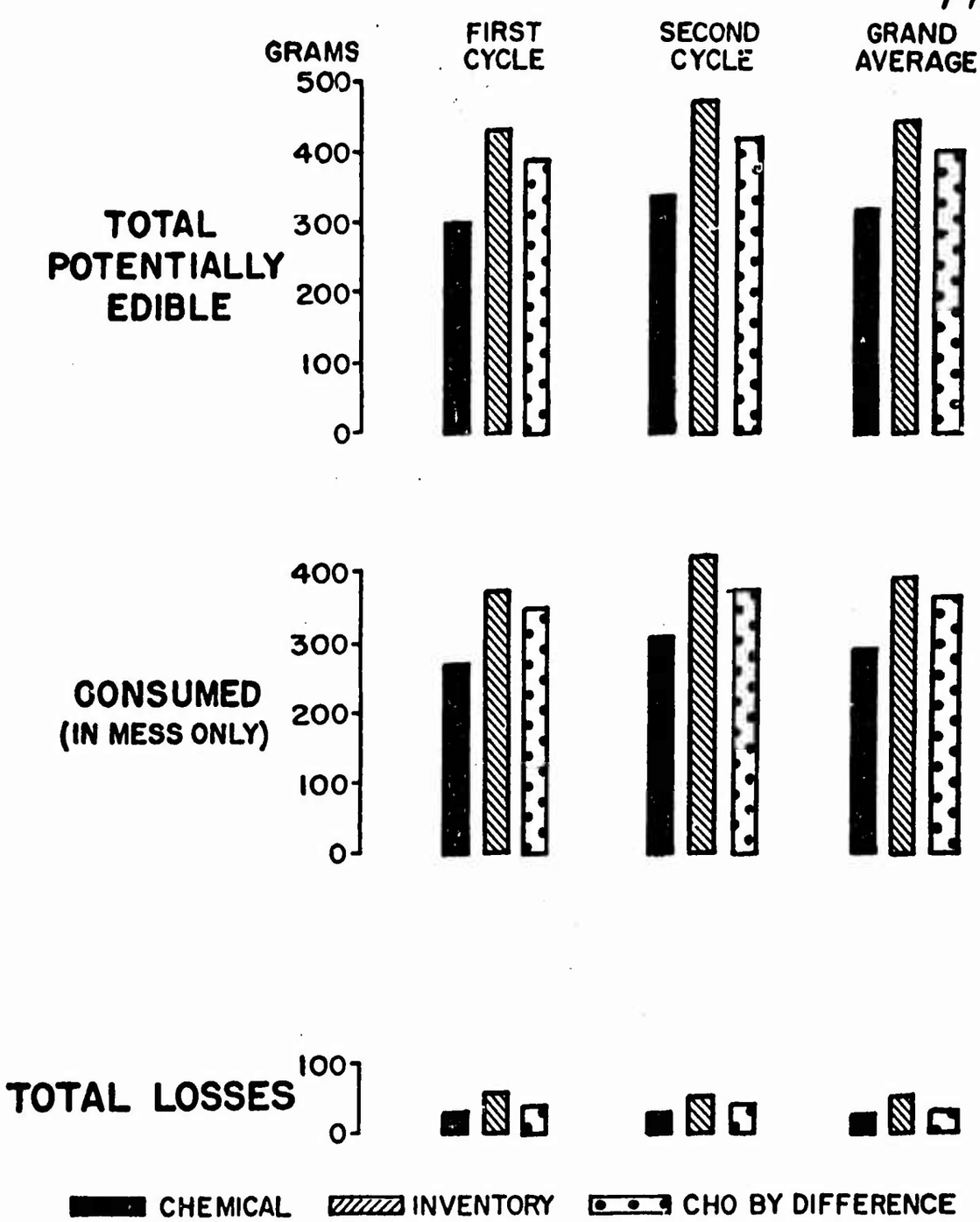


FIG. 5 SGT. SKALA COLLECTING KITCHEN WASTE

FIG. 6 SGT. MOONEYHAM AND CPL. ZOHNER GRINDING GARBAGE

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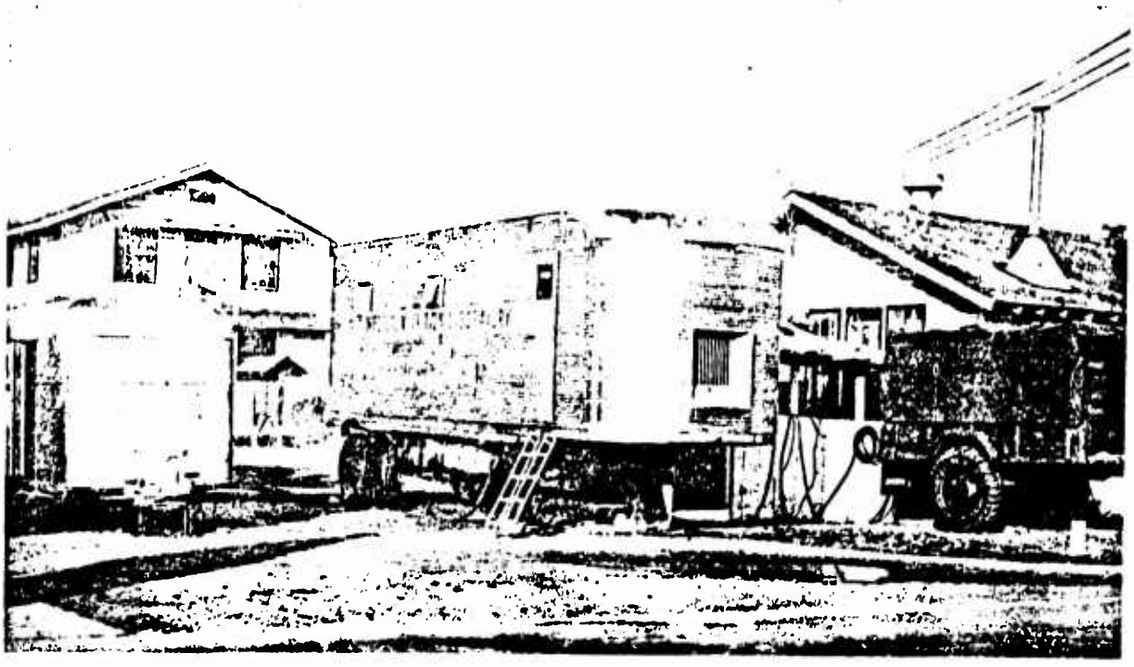

FIG. 7 LABORATORY TRAILERS IN USE AT FT. BENNING

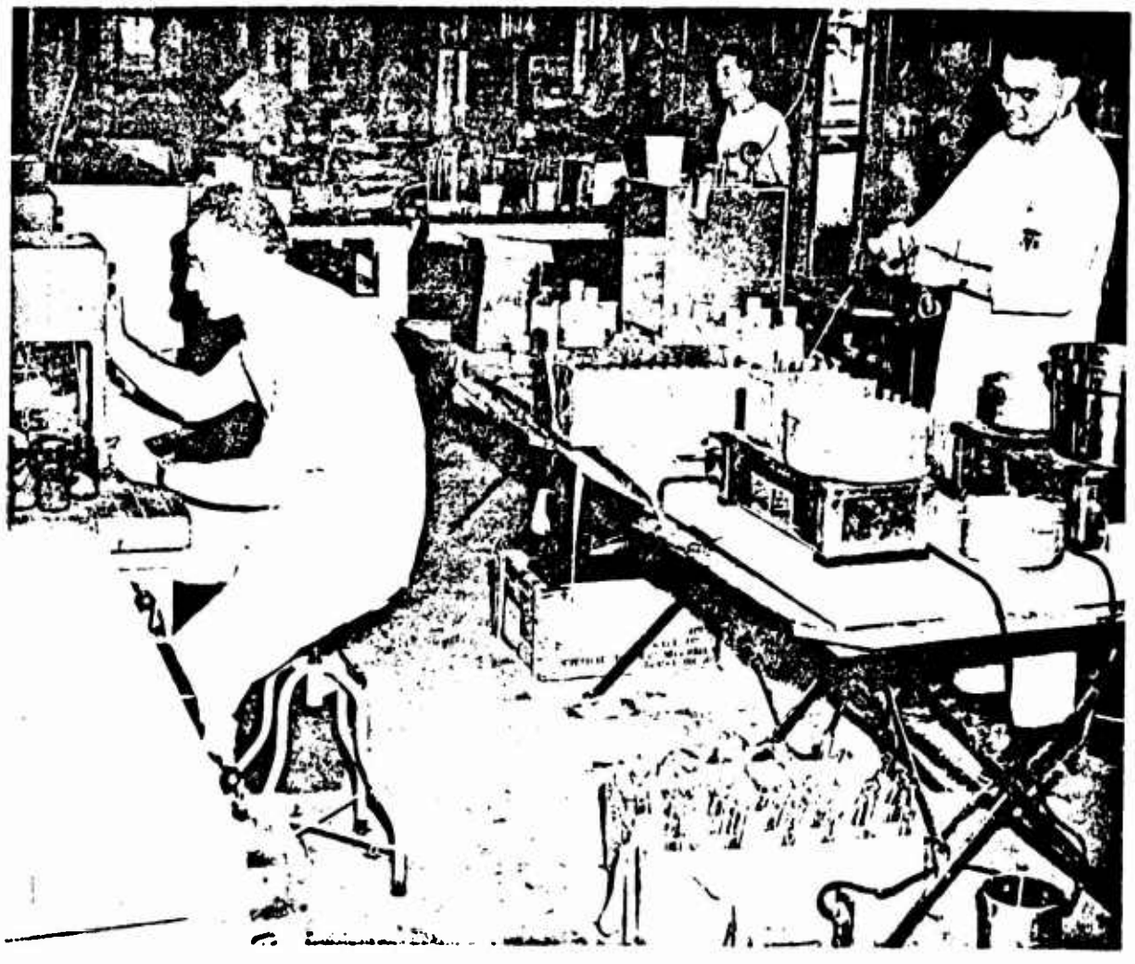

FIG. 8 MESS HALL USED AS A LABORATORY

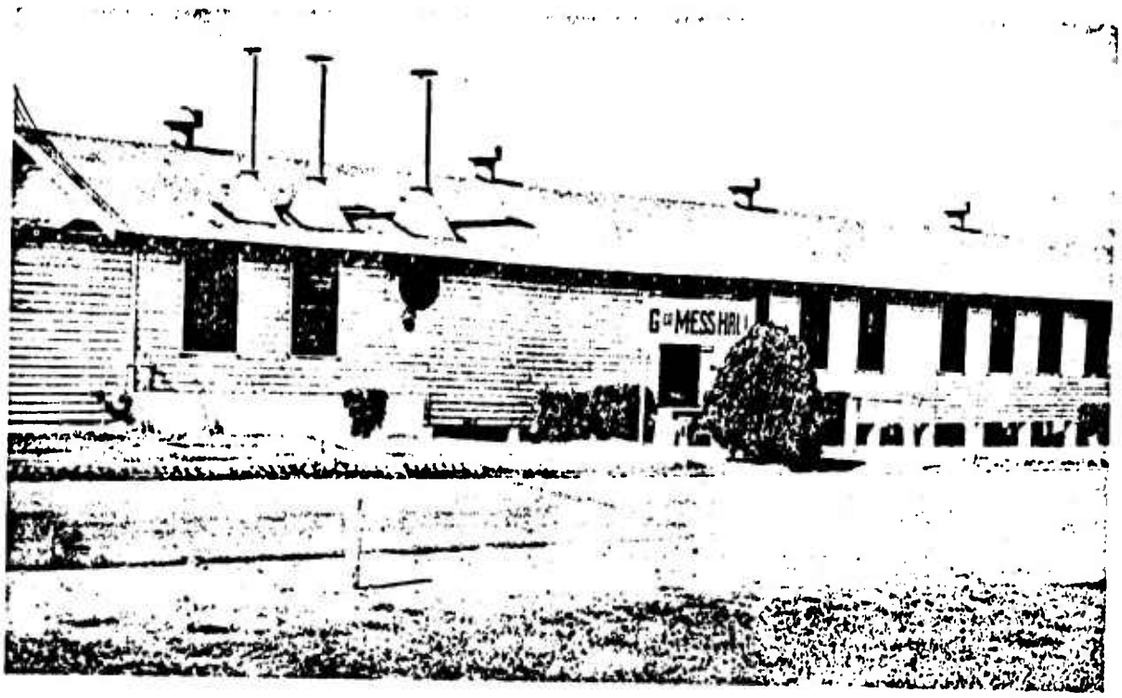

FIG 9 MESS HALL, FT. BENNING, GA.

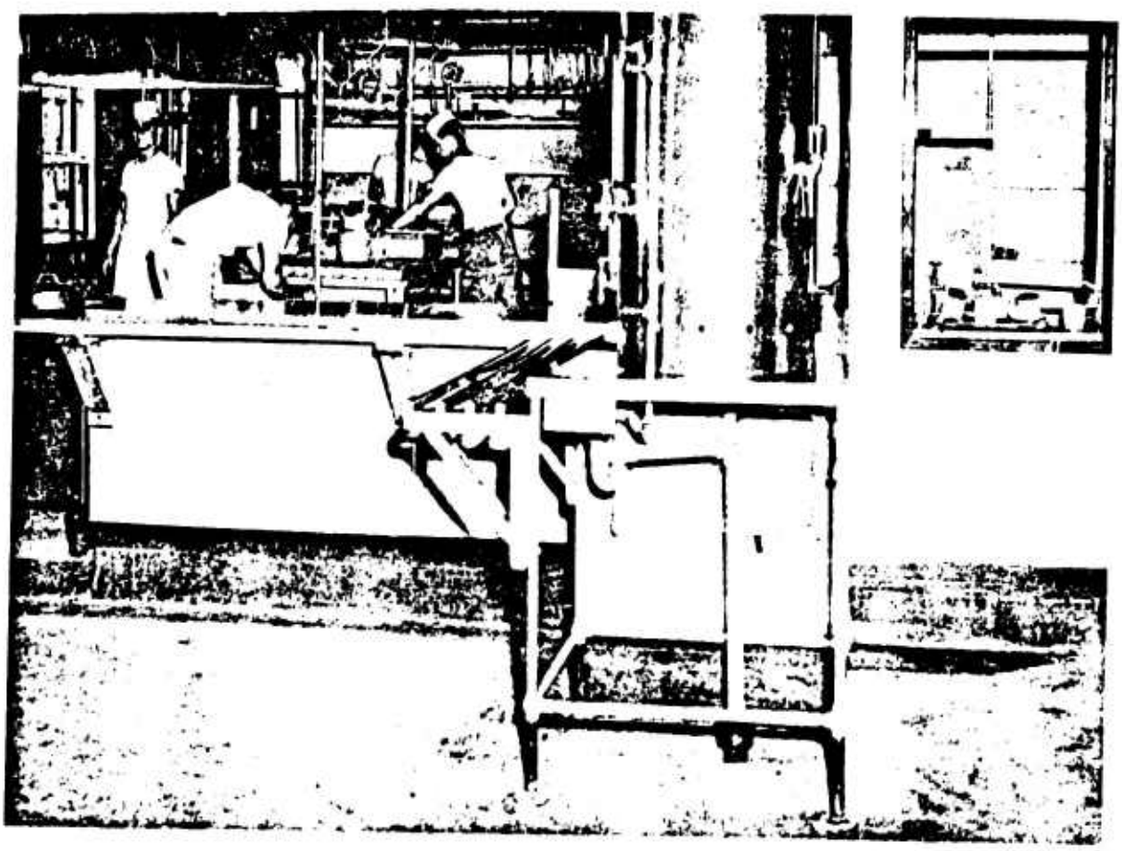

FIG. 10 INTERIOR OF MESS HALL, FT. BENNING, GA.

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FIG. 11 INTERIOR OF MESS HALL USED FOR A CHEMICAL LABORATORY

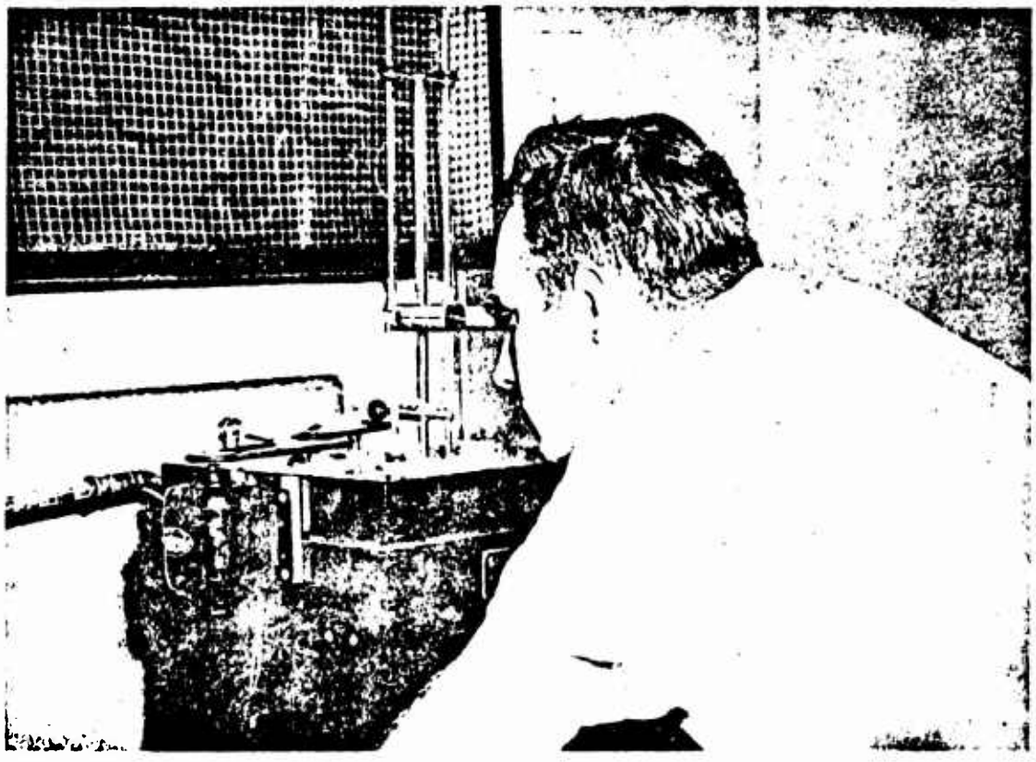

FIG. 12 SGT JOHNSON PERFORMING OXYGEN BOMB CALORIMETRY

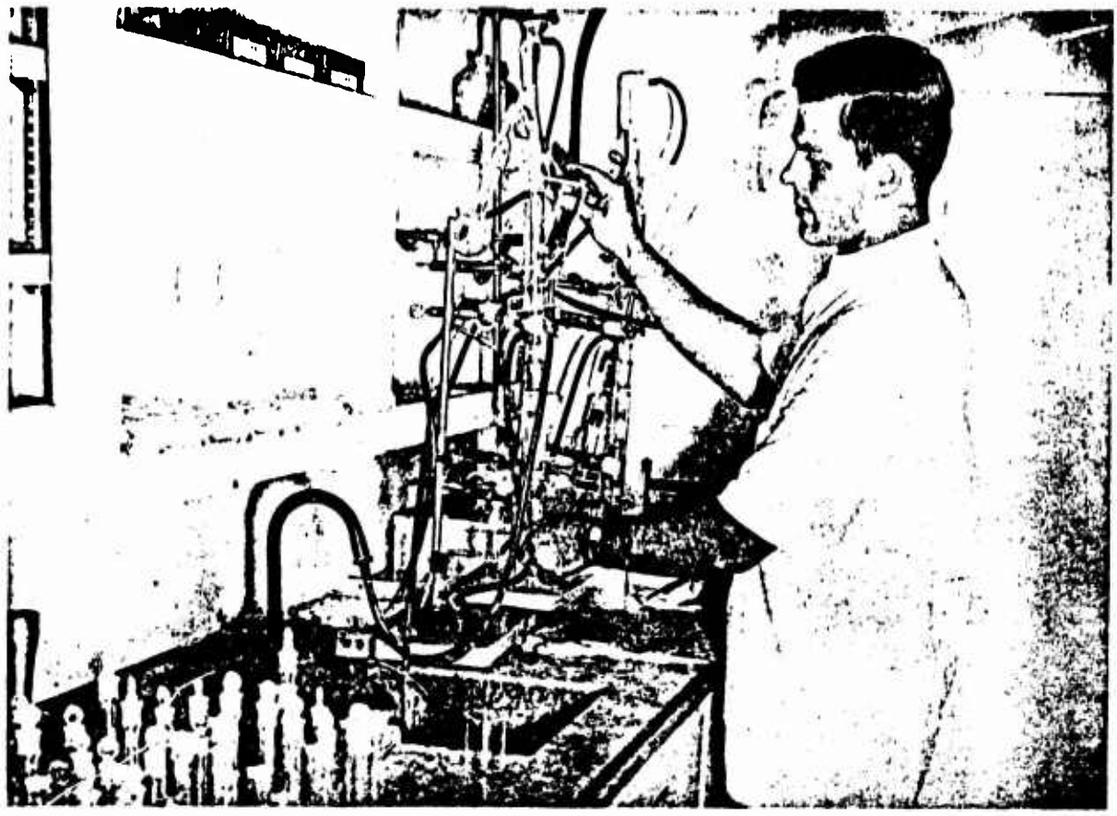

FIG. 13 SGT. MURPHY DISTILLING FOOD COMPOSITES FOR PROTEIN

FIG. 14 SGT. KATZANEK EXTRACTING FOOD SAMPLE FOR FAT ANALYSIS

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